

METEORS AND MIXTURES

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Problems of hylomorphic composition in
Aristotelian natural philosophy

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Abbreviations

- AT: *Œuvres de Descartes*, 11 vols. Edited by Ch. Adam and P. Tannery. (Paris: J. Vrin, 1996).
- CSM: *The Philosophical Writings of Descartes*, 2 vols. Edited and translated by J. Cottingham, R. Stoothoff, and D. Murdoch. (Cambridge: Cambridge University Press, 1984–1985).
- CSMK: *The Philosophical Writings of Descartes. Volume III*. Edited and translated by J. Cottingham, R. Stoothoff, D. Murdoch, and A. Kenny. (Cambridge: Cambridge University Press, 1991).
- DM: Francisco Suárez, *Disputationes metaphysicae*. Vols. 25 and 26 of *Opera omnia*, 28 vols. (Paris: L. Vivès, 1856–1868 [reprinted Hildesheim: G. Olms, 2009]).
- GP: G.W. Leibniz, *Die philosophischen Schriften*, 7 vols. Edited by C.I. Gerhardt. (Berlin: Weidmann, 1875–1890).
- LDB: *The Leibniz–Des Bosses Correspondence*. Edited and translated by B. Look and D. Rutherford. (New Haven: Yale University Press, 2007).
- Olscamp: R. Descartes, *Discourse on Method, Optics, Geometry, and Meteorology*. Translated by P. Olscamp. (Indianapolis: Hackett, 2001).
- Opera*: Petri cardinalis Pázmány Archi-episcopi Strigoniensis et primatis regni Hungariae *Opera omnia, Series Latina*, 6 vols. (Budapest: typis Regiae Scientiarum Universitatis, 1894–1905).

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Introduction

This is a study in the natural philosophy of Latin Aristotelianism, covering issues from the fourteenth to the eighteenth centuries.

The historiography of Latin Aristotelianism in the past thirty years has been heavily influenced by Charles Schmitt's thesis on the irreducible plurality of 'Aristotelianisms' in the Renaissance.¹ Schmitt's thesis has gained a wide popularity, be it only for the simple fact that historians have always been inclined to don the nominalist hat and look for particulars. Schmitt reacted to a reductive view of scholasticism in some of the older historiography, which sinned, according to him, by treating Aristotelianism as a monolithic block, or at least as a coherent tradition. One can find examples to support this criticism (e.g., Dijksterhuis's *The mechanization of the world picture*), but the extent to which the 'monolithic view' of Aristotelianism of the older scholarship is a retroactive construct of the

¹ C.B. Schmitt, *Aristotle and the Renaissance* (Cambridge, MA: Harvard University Press, 1983). See L. Giard, 'Charles Schmitt (1933–1986): Reconstructor of a History of Renaissance Learning', in *New Perspectives on Renaissance Thought. Essays in the history of science, education and philosophy in memory of Charles B. Schmitt*, ed. by J. Henry and S. Hutton (London: Duckworth, 1990), pp. 278–9; E. Kessler, 'The Transformation of Aristotelianism during Renaissance', *ibid.*, pp. 137–48; C.H. Lohr, 'The Sixteenth-Century Transformation of the Aristotelian Natural Philosophy', in *Aristotelismus und Renaissance. In memoriam Ch. B. Schmitt*, ed. by E. Kessler, C.H. Lohr, and W. Sparn (Wiesbaden: In Kommission bei Otto Harrassowitz, 1988), pp. 89–101. See also the older essays of P.O. Kristeller, such as 'The Aristotelian tradition', in his *Renaissance thought: the classic, scholastic and humanist strains* (New York, Evanston, London: Harper & Row, 1961), pp. 24–47.

‘pluralist view’ championed by Schmitt could also be a legitimate question. Nevertheless, Schmitt’s acknowledgement of the eclecticism in the sources and traditions that fuelled authors labelled as ‘Aristotelians’ has won over historians beyond the field of Renaissance philosophy. Medieval philosophy has witnessed studies on the degree of ‘Aristotelian conformity’ of one philosopher or the other, stressing their departures from a presumed standard of orthodoxy.² Historians of early modern philosophy have also become increasingly careful in contextualizing and correcting the Molière type of caricature that some early modern figures have painted over the scholastics.³ Edward Grant reached perhaps an extreme of

² See E. Grant, ‘Medieval departures from Aristotelian natural philosophy’, in *Studies in Medieval Natural Philosophy*, ed. by S. Caroti (Florence: Olschki, 1989), pp. 237–56, and in general much of Grant’s work; J. E. Murdoch, ‘From the medieval to the Renaissance Aristotle’, in *New Perspectives on Renaissance Thought*, pp. 163–76.

³ Among recent surveys, see C. Mercer, ‘The vitality and importance of early modern Aristotelianism’, in *The rise of modern philosophy: the tension between the new and traditional philosophies from Machiavelli to Leibniz*, ed. by T. Sorell (Oxford: Oxford University Press, 1993), pp. 33–67; R. Ariew and A. Gabbey, ‘The scholastic background’, in *The Cambridge history of seventeenth-century philosophy*, ed. by D. Garber and M. Ayers (Cambridge: Cambridge University Press, 1998), vol. 2, pp. 425–53; D. Garber, ‘The Aristotelian framework’, in *The Cambridge history of science. Volume III: Early modern science*, ed. by L. Daston and K. Park (Cambridge: Cambridge University Press, 2006), pp. 25–8; and the most comprehensive survey of seventeenth-century philosophy to date, *Grundriss der Geschichte der Philosophie. Begründet von Friedrich Überweg. Die Philosophie des 17. Jahrhunderts*, ed. by J.-P. Schobinger et al., 8 vols (Basel: Schwabe & Co., 1988–2001). M.R. Reif, *Natural philosophy in some early seventeenth-century scholastic textbooks*, PhD thesis (Saint Louis University: 1962) and P. Reif, ‘The textbook tradition in natural philosophy, 1600–1650’, *Journal of the History of Ideas* 30 (1969), pp. 17–32 remain essential. For the Aristotelian roots of early modern figures, see, among others, D. Des Chene, *Physiologia. Natural philosophy in late Aristotelian and Cartesian thought* (Ithaca: Cornell University Press, 2000); R. Ariew, *Descartes among the Scholastics* (Leiden, Boston: E.J. Brill, 2011); C.S. Leijenhorst, *The mechanisation of Aristotelianism: the late Aristotelian setting of Thomas Hobbes’s natural philosophy* (Leiden: E.J. Brill, 2002); and C. Mercer, *Leibniz’s metaphysics: its origins and development* (Cambridge, MA: Cambridge University Press), 2001.

Schmitt's thesis when he proposed that one should think of Aristotelianism as a 'population', in a biological sense, 'with no firm, cohesive body of doctrine'.⁴

And yet, one cannot help to remark the sense in which Latin Aristotelianism, as a tradition that has dominated European universities since their birth up the seventeenth and eighteenth centuries, is more homogenous than other major philosophical traditions, such as ancient philosophy and modern philosophy. There is some truth in Descartes's valiant claim that, regardless of the diversity found among the Aristotelians, they can all be refuted by attacking the common foundations on which they are substantiated.⁵ Hans Thijssen has recently challenged the prevalent agnosticism of this historiography, recognizing a 'shared conceptual framework' that explains a unique 'structure of continuity' of Aristotelianism.⁶ Paul Richard Blum's distinction between *Philosophenphilosophie* and *Schulphilosophie*, between the philosophy of independent thinkers working outside of the university and the philosophy of the schoolmen, is a good conceptual tool that grasps the closer similarity of discourse or the 'family resemblance' encountered in authors as diverse as Duns Scotus, John Buridan, and Giacomo Zabarella.⁷ The Aristotelianism of the school is fundamentally an

⁴ 'Ways to interpret the terms "Aristotelian" and "Aristotelianism" in medieval and Renaissance natural philosophy', *History of Science*, 25 (1987): pp. 335–58. See also the introduction of the editors to *The dynamics of Aristotelian natural philosophy from antiquity to the seventeenth century*, ed. by C. Leijenhorst, C. Lüthy, and J.M.M.H. Thijssen (Leiden, Boston, Cologne: E.J. Brill, 2002): 'The term Aristotelian has no clear essence.'

⁵ 'Pour la philosophie de l'École, je ne la tiens nullement difficile à réfuter, à cause des diversités de leurs opinions; car on peut aisément renverser tous les fondements desquels ils sont d'accord entre eux.' (AT III 231–2).

⁶ J.M.M.H. Thijssen, 'Some reflections on continuity and transformation of Aristotelianism in medieval (and Renaissance) natural philosophy', *Documenti e studi sulla tradizione filosofica medievale*, 2 (1991): pp. 503–28. Thijssen writes: 'I think that Schmitt's Wittgensteinian approach and Grant's population approach put too much emphasis on the diversity found among the Aristotelians.'

⁷ P.R. Blum, *Philosophenphilosophie und Schulphilosophie: Typen des Philosophierens in der Neuzeit* (Stuttgart: Franz Steiner Verlag, 1998); 'Philosophers' philosophy and school

exegetical genre. It reads Aristotle together with its more authoritative interpreters and it develops its doctrines, typically, in reaction to unnamed contemporary readings of one and the same text. The diversity of solutions encountered in Latin Aristotelianism does not preclude *a community of problems* that can be traced back to one interpreter or the other. Aristotelianism is not just a ‘philosophers’ philosophy’, but is also a philosophy that incorporates its own history, and which cannot be conceived without it. This thesis starts with the assumption that what constitutes the specificity of Latin Aristotelianism, as opposed to the *tabula rasa* of the early moderns, is its imposition of *a different model* of doing philosophy, centred on the commentary tradition of the Aristotelian corpus: *philosophy as exegesis*. The philosophy of the schools is not a doxography, but a creative reinterpretation of authoritative sources. Our guiding principle is that research into the sources of this culture is inseparable from research into its philosophical production.

If we accept this view, then the question why and how it is that Aristotelianism broke down becomes even more acute. There is no simple answer to the question. One of the underlying theses of the following studies is that Aristotelianism, as a conceptual structure, did not collapse in the seventeenth century—even though the university practice that sustained it did suffer—simply because it had never acquired a stable conceptual form. Schmitt was right in insisting that Aristotelianism is not a monolith. This suggests the possibility that a conceptual coherence between the core tenets of Aristotelianism is not to be taken for granted, and that some of the shared notions might not work quite so well with others. Because Aristotelianism draws on many heteroclite sources (Kristeller) and is constituted by the work of such diverse figures (Schmitt), one should expect a certain internal conceptual heterogeneity. I agree with Thijssen in that there is unity in the diversity of Aristotelianism. Without a small set of core beliefs concerning, e.g., the distinction between act and potency, the metaphysical analysis of body in terms of matter, substantial forms and accidental forms, the

philosophy’, in *Studies on Early Modern Aristotelianism* (Leiden, Boston: E.J. Brill, 2012), pp. 3–19.

theory of the four elements and of the four corresponding elemental qualities, or the fourfold structure of causality, the development of the undeniable common vocabulary of Aristotelianism is hard to explain. But I also want to add that this ‘common set of beliefs’ might not be, in itself, rock solid. What I would propose is to think of the Aristotelian tradition as coagulated around a common set of *conceptual conflicts*, of *problems* (Alain de Libera, following Collingwood, called them ‘structures constituted by questions and answers’).⁸ In short, I propose to submit Aristotelianism to a conceptual *Problemgeschichte*. I understand to join in this sense Dilthey’s notion (however out of fashion that may seem today) with MacIntyre’s definition of ‘tradition’ as ‘a conflict of interpretations of that tradition, a conflict which itself has a history susceptible of rival interpretations’.⁹ This should not invite the reading that Aristotelianism collapsed because of an irreducible internal incoherence, as it has been suggested (for instance by Anneliese Maier), simply because the internal conflicts I speak of are themselves evolving throughout history. If we take MacIntyre seriously, the conceptual conflicts that constitute a tradition are not *within* Aristotelianism from the beginning, waiting to be resolved at some point by an intrepid mind, but are created by the succeeding rival interpretations of Aristotle. Looking at Aristotelianism as a history of problems should foster, instead, an appreciation of the richness of this tradition without dissolving it into particular, autonomous figures and ideas.

The following studies investigate some of the conceptual conflicts generated by the Aristotelian notions of *hylomorphism*, *mixtures*, and *meteors*. I

⁸ A. de Libera, *La référence vide. Théories de la proposition* (Paris: Presses Universitaires de France, 2002), pp. 23–4 and his inaugural lecture at the Collège de France, 13 February 2014. R.G. Collingwood, *An autobiography* (Oxford: Oxford University Press, 1940), p. 37.

⁹ A. MacIntyre, ‘Epistemological crises, dramatic narrative and the philosophy of science’, *The Monist* 60 (1977): pp. 453–72. I thank Maarten Van Dyck for suggesting this reference to me and for his comments on these issues.

approach different intellectual settings from the fourteenth, the sixteenth and the seventeenth centuries, looking at the birth, the development and the demise of the Aristotelian science of ‘meteorology’. The historiographical thread that follows different readings of Aristotle’s *Meteorologica* is doubled by a conceptual analysis of the Aristotelian notion of *mixture* and of the doctrine of *hylomorphic composition* in mixed bodies. The choice of these three notions, hylomorphism, mixtures and meteors, need not seem peculiar. Aristotelian ‘meteorology’ is a science that has little to do with our modern discipline. It is based on the ontology of mixtures and delimited within the late Aristotelian course of physics following hylomorphic criteria: meteors are defined as imperfect mixtures, a special type of bodies in-between pure elements and complete mixtures, with the specificity that they do not have a substantial form of their own.

Owing to their instability and peculiar hylomorphic composition, the meteors are, in fact, quite the opposite of Aristotle’s primary substances. For Aristotle, material bodies have a double conceptual determination: they are mixtures of the four elements and, at the same time, they are composed out of matter and form. Hylomorphism is meant to explain, foremost, not what bodies are made of but how do they change by passing from one form to another. The theory of elements and mixtures, on the contrary, is meant to explain what is the ultimate structure of bodies. The use of hylomorphism in the scientific description of mixtures generates a number of difficulties: are the elements themselves composed out of matter and form? Do the forms of the elements survive in the mixture? How is the substantial form of the mixture acquired? Do mixtures have one single substantial form? Can there be imperfect substances, such as meteorological bodies, midway between the elements and complete mixtures?

The core of my analysis is concerned with the conceptualization of meteorological bodies as mixtures and with the question of how hylomorphism structures the Aristotelian course of physics. Hence these studies are also meant to tell a fragmented story about the development of hylomorphic theory in Latin philosophy, looked at from the backdoor as it were, through the challenges it faced and through its failures, rather than through its astonishingly lasting success as a theory of matter and change. It occurred to me that there are two types of histories of hylomorphism that one can attempt. One can lay down a doctrinal

history that retraces the different readings and interpretations philosophers have given to Aristotle's metaphysical principles of body and change. One could talk about issues such as the unicity or plurality of forms in a composed substance, the possibility of the separated existence of form and matter, the notions of prime matter, actuality and potentiality, the causal or descriptive functions of substantial forms, and so forth. We can call this Aristotelianism *in potentia*: these doctrinal commitments regarding hylomorphic theory are laid down in discussions over the general principles of nature meant to serve as a preliminary to the applied scientific study of nature. They are presented prior to and somewhat independently of their use in scientific practice. They are part of a *discourse on method* rather than of the *essays* themselves, to use a Cartesian metaphor. Although a synthetic historical overview that would cover the middle ages and the early modern era is yet to be attempted,¹⁰ we dispose today, to a large extent, of the doctrinal micro-histories needed of such a history. We generally know what the major figures thought about hylomorphism. But one can also attempt to approach the history of hylomorphism *in actu*, that is, on the one hand, to look for the problems raised by hylomorphic theory in the practice of natural philosophy—for instance, when trying to explain the structure of mixed bodies or the nature of the meteors—and, on the other hand, to pay attention to the particular, limited contexts where these problems are raised, independent of a teleological bird's-eye view of history. Simply put, instead of a doctrinal history, a history of the application of a doctrine, in determined settings. Although this seems like a titanic enterprise, the approach has one advantage: because some of the core elements of hylomorphic theory are in fact constant throughout its philosophical lifespan in Latin philosophy, one can point out, through micro-histories, problems that are likely to arise again in other contexts. One can envision the project of an archaeology of the notion of hylomorphism, a notion that resurfaces in different contexts and that gives rise to different conceptual conflicts. Such a history will necessarily be open ended. It will be pieced together

¹⁰ R. Pasnau, *Metaphysical Themes, 1274–1671* (Oxford: Oxford University Press, 2011), comes close to such an overview.

from individual narratives and ideological plots belonging to particular intellectual milieux. This kind of micro-archeology, as opposed to a genealogy of doctrines, will necessarily not provide a coherent story of the development of a concept or of a philosophical idea. But history itself is neither consistent nor coherent, and much less so the history of concepts. It will provide, instead, a deepening of our understanding of how metaphysical doctrines are put to work to solve problems of natural philosophy.

The scholarship available on the Latin commentaries to Aristotle's *Meteorologica* is currently underdeveloped. We can count only two book-length studies dedicated to it: François de Dainville's monumental study of geography in Jesuit authors, which covers the period from 1525 to 1700 and remains an unrivalled source of information,¹¹ and Craig Martin's commendable study of Italian meteorology in the Renaissance, which covers a variety of authors from Pomponazzi to Cabeo, and tries to place Descartes on that background.¹² To these, if we add a number of sporadic articles, a PhD thesis on Buridan's first book, and a couple of instruments, such as Lohr's inventories of Latin Aristotle commentaries and Hellmann's inventory of German meteorological treatises, our bibliography is virtually complete.¹³ Aristotle's *Meteorologica* itself has not been

¹¹ F. De Dainville, *La géographie des humanistes* (Paris: Beauchesne, 1940).

¹² C. Martin, *Renaissance meteorology. Pomponazzi to Descartes* (Baltimore: John Hopkins University Press, 2011). Cf. my review 'Renaissance meteorology and modern science', *Metascience* 22 (2013): pp. 155–8.

¹³ É. Gilson, 'Météores cartésiens et météores scolastiques', *Revue néo-scholastique de philosophie* 22 and 23 (1920 and 1921), reprinted in *Études sur le rôle de la pensée médiévale dans la formation du système cartésien* (Paris: J. Vrin, 1930), pp. 102–37. See D. Bellis, 'Météores cartésiens et météores scolastiques: la lecture philosophique d'Étienne Gilson', *Alvearium*, forthcoming. S. Bages, *Les Questiones super tres libros Metheororum Aristotelis de Jean Buridan: étude suivie de l'édition du Livre I* (PhD thesis: École nationale des chartes, 1986). L. Thorndike, *A History of Magic and Experimental Science* (New York:

subjected to a thorough modern commentary until Malcolm Wilson's very recent study.¹⁴

As said, our research into the avatars of meteorology is also a research into the avatars of hylomorphism. Although one may see it as a metaphysical concept used to describe the structure of reality, hylomorphism is foremost a physical tool that explains the behaviour of bodies. Its use in the scientific description of mixed bodies (hylomorphism *in actu*) encounters a number of difficulties: mixture is a notion underdetermined by Aristotle that has puzzled both Arab and Latin philosophy constantly because of the difficulty of conceiving it in the framework of hylomorphic composition (chapter 2); meteors, imperfect mixtures, that do not have a form of their own, are a peculiar type of body at the exact opposite of Aristotelian primary substances (chapters 3, 4 and 5); the description of the living

Columbia University Press, 1958), vol. 8, pp. 53–4. C. Meinel, 'Les Météores de Froidmont et les Météores de Descartes', in *Libert Froidmont et les résistances aux révolutions scientifiques. Actes du Colloque Château d'Oupeye, 26 et 27 septembre 1987*, ed. by A.-C. Bernès (Haccourt: Association des vieilles familles d'Haccourt, 1988), pp. 105–29. C.H. Lohr's series of 'Medieval Latin Aristotle commentaries' and 'Renaissance Aristotle commentaries', published in *Traditio, Studies in Renaissance and Renaissance Quarterly* between 1967 and 1982; idem, *Latin Aristotle Commentaries II. Renaissance authors* (Florence: Olschki, 1988). G. Hellmann, *Repertorium der deutschen Meteorologie* (Leipzig: Wilhelm Engelmann, 1883). Hellmann's other minute and erudite studies of various topics from the scientific history of meteorology, published between 1914 and 1922 in the *Abhandlungen der Preussischen Akademie der Wissenschaften*, are also worthy of note. Other studies of some relevance for our purpose: J. Lamine, *Les quatre éléments. Histoire d'une hypothèse* (Bruxelles: Hayez, 1904); L. Dufour, 'Les grandes époques de l'histoire de la météorologie', *Ciel et Terre* 59 (1943): pp. 355–9; J. Ducos, *La météorologie en français au Moyen Âge: XIII^e–XIV^e siècles* (Paris: H. Champion, 1998); S.K. Heninger, *A handbook of Renaissance meteorology: with particular reference to Elizabethan and Jacobean literature* (Durham, NC: Duke University Press, 1960); V. Jancovic, *Reading the skies: a cultural history of the English weather, 1650–1820* (Manchester: Manchester University Press, 2000).

¹⁴ M. Wilson, *Structure and Method in Aristotle's Meteorologica: A More Disorderly Nature* (Cambridge: Cambridge University Press, 2013).

body in hylomorphic terms seems like the easiest thing to reject once mechanistic explanations are acquired (chapter 6); finally, attempts to revive the doctrine in the eighteenth century are doomed to fail (chapter 7).

Chapter 1 serves as a preface to the subsequent chapters, by investigating the Aristotelian notion of *scientia* and the nominalist interrogations around it. It focuses on the questions on meteorology published in the seventeenth-century Franciscan edition of Duns Scotus, which served as the standard text of the Subtle Doctor until the twentieth century. Although the authenticity of this text was questioned by the editor himself, Luke Wadding, it entered into the Scotist tradition and was regarded as a work by Scotus until the modern exegesis of Duhem and Brikenmajer. By reviewing the meteorological literature produced in this period, I was able to reveal a contamination in the text and to recognize an incomplete copy of Themon Judaeus's questions on Book IV of *Meteorologica* in the text printed by Wadding. Through a doctrinal commentary of the first question of Pseudo-Scotus on *Meteorologica*, we can also better situate the rest of the text in the Parisian intellectual setting of the second half of the fourteenth century.

The question on whether meteorology is a science shows also how the text of Aristotle's *Meteorologica* can generate very diverse types of concerns, depending on context. Pseudo-Scotus's text treats an epistemological problem that arose in the fourteenth century on what is the object of science—either the thing known, the conclusion of a demonstrative syllogism, or the 'state of affairs' of the known scientific fact. This discussion emerged in the first half of the fourteenth century in Oxford, in the debates surrounding Ockham's intrepid epistemological claims. It was imported very quickly in Paris, where it gained notoriety through Gregory of Rimini's rendering of the solutions developed in Oxford. It has occupied the masters of the University of Paris up until the first decades of the sixteenth century, only to fade away with the eclipse of the Parisian *nominales*. The view developed by Pseudo-Scotus and others in this context was that the object of science is neither the conclusive sentence of the scientific proposition, nor the agreement of the conclusive sentence with the facts of the world (the *significabile complexe*), but the *things* of the outside world known in themselves—a knowledge mediated, nevertheless, through the conclusions of

demonstrative syllogisms. This concordist solution is, I argue, mainly the result of theological pressure. Gregory of Rimini's notion of the *significabile complexe* was rejected because of a misreading of the signifiabiles as ontologically separable from the signified things, arriving at the upsetting view of having a type of entities co-eternal with God. There is virtually no trace of this view in the epistemological scene of the seventeenth century. The sixteenth and the seventeenth centuries returned to a more traditional exploitation of the *Posterior Analytics*, by refining the *a posteriori* and *a priori* methods of exposition already digested by the masters of the thirteenth century. Hence the value of this narrative sits, in my opinion, in the unmatched originality with which it poses the problem of the scientific grasp of facts, language and knowledge, challenging the epistemological optimism typical to Aristotelianism. It is also an excellent example of a *new*, self-contained 'conceptual conflict' that arose in the Aristotelian tradition, one that cannot be traced to previous interpretations, thus vouching for the usefulness of a history of problems in determined settings described earlier. Since it had virtually no posterity, this nominalist discussion shows that insights are gained and lost, and that a non-linear narrative of Aristotelianism is warranted.

Chapter 2 presents the Aristotelian theory of mixture and reviews the main interpretations provided in the Middle Ages: those of Avicenna, Averroes, Thomas Aquinas, and Duns Scotus. In chapter 10 of the first book *On Generation and corruption*, Aristotle describes mixture as a process distinct from alteration, generation or corruption. The problem faced by the medieval exegesis of Aristotle was, in Anneliese Maier's terms, how to conciliate the doctrine of hylomorphic composition with elemental theory: do the forms of the elements remain in the mixture? On the one hand, if the forms of the four classical elements do not remain in the mixture, it becomes hard to understand how it is that the mixture can be said to consist *out of* the four elements and how the process of mixture is different than a simple generation of a new substance. On the other hand, keeping the elemental form in the mixture violates the generally shared principle that a substance has one single substantial form, which defines it as a species and provides the ontological unity of the mixture. This discussion has occupied the Aristotelian exegesis of *On generation and corruption* continuously, until the seventeenth century and beyond. The four main solutions proposed by medieval

authors revolved around keeping a ‘remitted’ version of the elemental forms or qualities in the mixture, which forces, in a way, the accommodation of the theory of mixture to hylomorphic theory. The elements, according to the medieval reading of Aristotle, are kept in the mixture *in potentia*, not *in actu*. The most widely-followed of the theories on what exactly does it mean for the elements to endure *in potentia* was that proposed by Thomas Aquinas. Saint Thomas maintained the permanence of the elemental *qualities* in the mixture, and not that of elemental substantial forms. While Scotus has been regarded in the literature as developing a Thomist view on mixture, I show that he had quite a radical position and that he rejected the Aristotelian theory of mixture altogether. Contrary to Thomas, Scotus held that the elements do not remain in the mixture neither with respect to their form, nor with respect to their qualities, and that the combination of the four elements that would give rise to a mixture is not possible at all.

Chapter 3 continues the discussion of Anneliese Maier’s thesis over the incompatibility between hylomorphism and the theory of mixtures in Latin Aristotelianism started in the previous chapter. It looks at the evolution of the exegesis to Aristotle’s *Meteorologica* in the Jesuit course on physics at the end of the sixteenth century. The focus is Péter Pázmány, author of a course on physics taught at the University of Graz in 1598–1600, who asks acute questions concerning the conceptual coherence of the Aristotelian corpus. The sixteenth-century pedagogical exegesis of Aristotle’s *Meteorologica* faced the problem of assigning a place in the course on physics for this heterogeneous material, and questions of doctrinal coherence become central in this context. Suspicions over the authenticity of Book IV of *Meteorologica* had become more pressing with the rediscovery of the Greek commentators, and especially that of Alexander of Aphrodisias, who had proposed to separate Book IV from the rest of the work. Indeed, Book IV of *Meteorologica* treats material quite different from the first three books: while the first three books are concerned with meteorological phenomena that arise from vapours and exhalations, Book IV is concerned with the work of the four elemental qualities and ends in a theory of organism. By the sixteenth century, Book IV came to be read as dealing with perfect mixtures, while the first three books came to be read as treating imperfect mixtures, meteors

proper. Pázmány's disputations are situated in the middle of this displacement. He presents the arguments for and against the authenticity of Book IV and argues for integrating it, together with the first three books, into a coherent field of study of natural mixtures, both perfect and imperfect. Hylomorphic theory is used in this way to coagulate the discipline of meteorology around the ontological notion of mixtures.

The second problem raised by hylomorphic theory in Pázmány's lectures is that of putrefaction, a traditional meteorological topic from Book IV. The notion of putrefaction challenges the hylomorphic model of change through either alteration or immediate generation and corruption. Given the constraints of this general model of change, is putrefaction a case of corruption or is it a case of alteration? In his analysis of putrefaction as a phenomenon that combines alteration with corruption, Pázmány is brought to defend a view of the succession of forms that characterizes all mixtures, not only the animated mixtures, as it was commonly held. His argument counts as a case of conciliation between the theory of the four elements and hylomorphic theory in late Aristotelianism (i.e., against Anneliese Maier's claims over their fundamental incompatibility). It shows how the sixteenth-century exegesis of Aristotle recognized conceptual conflicts internal to Aristotelianism and sought to solve them.

Chapter 4 studies one of the most important meteorological treatises of the seventeenth century, Libertus Fromondus's *Meteorologicorum libri sex* (1627). Fromondus started his career as a man of science, preoccupied with 'celestial philosophy', as he calls it. He published some astronomical works before writing a book on meteorology, a subject that, he feels, has been neglected by his fellow Aristotelians. Throughout the book, Fromondus is defending the Aristotelian meteorological orthodoxy in the face of increasing innovations coming from Renaissance thinkers. I study, through his book, how the conceptual construction of Aristotelianism is applied to meteorological questions, from the elemental qualities, the locomotive qualities to the different types of causes involved in the scientific accounts. The chapter gives an analysis of the general theory of the meteors representative for the seventeenth century, based on Fromondus's first book, treating the definition of the meteors, the atmosphere as the place where they arise, and their common causes. To this, I add some selective

material from the rest of the treatise, together with comparative material from Iohannes Beverus and from the course of the Collegium Conimbricense. With Fromondus, we have the perspective of a genuine scientific treatise, which puts Aristotelianism to work, beyond preoccupations for the internal coherence of Aristotle apparent in the commentary literature.

Chapter 5 is a study of Descartes's treatise *The Meteors* published as part of the *Essays* of 1637. Descartes's small essay marks the end of Aristotelian meteorology as defined by the theory of mixtures that we have investigated. I situate it at the core of the shift of meteorology from a science based on ontological principles to one based on geographical delimitations. Once Descartes rejects the medieval notion of imperfect mixtures, as part of his critique of material hylomorphism, meteorology is defined by the geographical position of its object of study (in the near atmosphere), and not by the distinct metaphysical structure of the bodies it deals with. The way in which early Cartesian authors like Jacques Rohault, Jacques du Roure, and Pierre-Sylvain Régis integrate meteorological topics in their course on physics captures the consequences of Descartes's rejection of the Aristotelian theory of mixture on the development of meteorology as a discipline.

Making sense of this Cartesian revolution involves placing the essay both in the context of contemporary meteorology and in the development of Descartes's thought. In retracing the project and the reception of *The Meteors*, I establish that Descartes puts forward two radical and interconnected theses in this treatise: one is the rejection of the distinction between perfect and imperfect mixtures, which served as the basis for the constitution of Aristotelian meteorology; the other one is the rejection of real qualities as principles of scientific explanation. *The Meteors* appear as an essay in anti-Aristotelian physics, although Descartes refrains himself from mounting an open attack against the physics of the School. The treatise takes up the role of an *a posteriori* demonstration, half of a proper demonstration, from which the underlying principles are missing. In the second part of the chapter, I look closer at these hidden principles. I analyse the arguments against hylomorphism that Descartes provides in the *Sixth Set Replies*, in *The World* and in the *Rules for the direction of the mind*, to conclude that what grounds the argument is the identification of

extension with matter, rather than the thesis of the real distinction of substances. I argue thus that Descartes had already, before the publication of *The Meteors*, a sustained meditation over the reduction of matter to extension that implied a denial ofhylomorphism.

To the main study of meteorology as a science of mixtures, I add a second part that follows episodes from the development of hylomorphism in the early modern period, in different and divergent directions. One is concerned with the rejection of hylomorphism and the Aristotelian reaction to it, the other with an attempt to revive hylomorphism and to return at an Aristotelian notion of corporeal substance.

In chapter 6, I argue that, for some of Descartes's contemporaries, the most scandalous implication of his rejection of hylomorphism was the reduction of the vital powers of the animal soul to mechanistic principles. While seventeenth-century Aristotelians were somewhat less resistant to the Cartesian idea that material bodies are best described in corpuscular terms, rather than in hylomorphic terms (after all, others had gone down the same path), Descartes's rejection of the vegetative power of the soul was perceived as a stronger menace to their doctrinal body. Some readers quickly expressed the concern that this idea can incite less respectful people to reduce even the operations of the intellectual soul to mechanical principles. Descartes and his followers, on the contrary, saw in the denial of the animal soul a way of enforcing the exceptional place of man in Creation. This study presents the development of an exchange between Descartes, Henricus Regius, Fortunatus Plempius and Libertus Fromondus, in a discussion that starts from the question of the circulation of the blood and the origin of the heartbeat, to arrive at the more general question of the rejection of the animal soul, which was also part of the doctrine condemned in Leuven in 1662–1663. I show that in the exchange between Descartes and Plempius from 1637–1638, the latter's concern was Descartes's mechanistic account of the origin of the heartbeat, rather than his theory of the circulation of the blood, and that he finally adheres to Harvey's account of the heartbeat as a way to critique Descartes's. Plempius's concerns are further catalysed by Regius's involvement, who ends up developing his own parallel mechanistic account of the origin of the heartbeat. Plempius continues his attacks against Descartes through the subsequent editions of his

Fundamenta physices, culminating in 1654 with the mounting of a ‘censorship’ of Cartesianism, made up of letters he had demanded from a number of his colleagues in Leuven, including Fromondus. Finally, the events of 1662–1663 show that the question of the animal soul played an important role in the condemnation of Cartesianism in Leuven.

Chapter 7 presents Des Bosses’s attempt of a revival of the Aristotelian notion of corporeal substance in the eighteenth century, in his confrontation with Leibniz. By Leibniz’s time, one of the marks of demarcation of the *recentiores* from the School had come to be the rejection ofhylomorphism. There were many figures that contributed to this Anti-Aristotelian rhetoric, starting in the late sixteenth century and continuing vigorously into the seventeenth century. But there were also ecumenical figures, who advocated incorporating hylomorphism in the new mechanical philosophy. Leibniz is definitely one of the accommodationists. When he introduces the notion of a substantial bond in the correspondence with Des Bosses, Leibniz presents it as the solution to securing an Aristotelian notion of a corporeal substance. As the exchange between the two men progresses, it becomes clear that there are serious problems in conciliating Leibniz’s monadology with the new notion of the substantial bond, and the Aristotelian corporeal substance sought thereafter becomes increasingly insecure. The chapter examines more extensively Des Bosses’s views and his reasons for resisting Leibniz’s substantial bond. I show that Des Bosses had strong views regarding the real distinction between matter and extension and that this is the most important reason behind his rejection of Leibniz’s notion. Des Bosses had developed his philosophical project in a late letter from 1735, where he projects a metaphysical treatise called ‘Clavis Lycaeï’. Roughly one century after Descartes’s reduction of matter to extension, Des Bosses uses Leibnizian elements to argue for the real distinction between matter and extension, a thesis that would allow him to reintroduce a hylomorphic view of corporeal substance.

Part I. Meteors and mixtures

1 *Utrum de meteorologicis sit scientia*. Pseudo-Scotus and fourteenth-century meteorology

The mass of works developed around Aristotle's *Meteorologica* throughout the centuries does not constitute a homogeneous genre and can hold many surprises. The themes treated vary widely in the medieval literature and we often encounter subjects that have no direct connection with Aristotle's text. I start with a fourteenth-century text that develops an epistemological question: is meteorology a proper *scientia*, as defined by Aristotle? This will serve as a preface to the treatment of natural philosophical developments from the following chapters.

Parisian natural philosophy in the fourteenth century has been the object of increased interest in medieval studies for over a century now, but not much scholarly attention has been paid yet to the distinct and sophisticated literature on *Meteorologica* produced in this intellectual setting. One can find a similar set of meteorological questions developed by major figures of this period, such as John Buridan, Nicole Oresme, Albert of Saxony and Themon Judaeus. With the exception of the latter, whose work was published in the sixteenth century, most of this material is still to be edited.¹ It is notoriously hard to trace filiations

¹ For bibliographical indications and references to manuscripts, see O. Weijers, *Le travail intellectuel à la Faculté des arts de Paris: textes et maîtres (ca. 1200–1500)*, 9 vols. (Turnhout: Brepols, 1994–2012), s.v. An edition of the questions on the first book by Buridan is available: S. Bages, *Les questiones super tres libros metheorum de Jean Buridan: Étude*

between these figures, who were members of what has been characterized as a close intellectual network, in many ways quite unique in the Middle Ages.² Our grasp of *Meteorologica* literature is made particularly difficult by the heavy contaminations encountered in the manuscript tradition, which raises many questions of intellectual paternity, even down to the level of particular questions. Aleksander Birkemnajer was the only scholar who had extensive knowledge of this literature, but unfortunately he never completed his projected book on the subject. His work from the beginning of the last century offers nevertheless the basis for our current knowledge.

The purpose of our study is to provide a critical overview of this literature and some new material elements regarding another work that belongs to this genre: the text published as *Meteorologicorum libri quatuor* by Luke Wadding in the seventeenth-century edition of Duns Scotus, attributed to Duns Scotus until the twentieth century, and to Simon Tunsted since then. Pointing out yet another important contamination, I trace the intellectual paternity of Book IV of this text to Themon Judaeus, a Parisian master rediscovered by Pierre Duhem. The author of the rest of the work remains unknown (I will call him Pseudo-Scotus), but we can place its composition in the second half of the fourteenth century, in a Parisian setting influenced by Gregory of Rimini and John Buridan.

This literature is important both for our efforts of reconstructing the connections between the Parisian masters and for our knowledge of their scientific production. Optical issues developed in the third book constitute the main point of focus of such works, but they also discuss celestial influences, the nature of the sublunary bodies, the nature of light, causation or motion, and many other natural philosophical topics of interest. Specific to the fourteenth century is

suivie de l'édition du livre I, PhD thesis (École nationale des chartes, 1986). I thank Ms. Sylvie Bages-Biet for giving me access to her thesis.

² See J.M.M.H. Thijssen, 'The Buridan School Reassessed. John Buridan and Albert of Saxony', *Vivarium* 42 (2004): pp. 18–42 and 'The Debate over the Nature of Motion: John Buridan, Nicole Oresme and Albert of Saxony. With an Edition of John Buridan's *Quaestiones super libros Physicorum, secundum ultimam lecturam*, Book III, q. 7', *Early Science and Medicine* 14 (2009): pp. 186–210.

an epistemological discussion that introduces the book, with little grounding in Aristotle's text: what is the proper object of a *scientia*? While all authors mention the question of the object of meteorology, within the wider framework of the question of the object of scientific knowledge, Pseudo-Scotus is the only author encountered who has a thorough treatment. I therefore complement the critical note with a commentary of question 1 of Pseudo-Scotus, 'Utrum de impressionibus meteorologicis sit scientia'. The presentation of this discussion from the *Meteorologica* literature aims to contribute to our knowledge of the reception of English nominalism in Paris.

1.1 Critical study. The *quaestiones* of Pseudo-Scotus and Themon Judaeus

1.1.1. It is known that the series of *quaestiones* on Aristotle's *Meteorologica* published by Luke Wadding (1588–1657) in the seventeenth-century Franciscan edition of Duns Scotus is not the work of Duns Scotus, in spite of the qualification of the text as 'secundum Scotum' in some of the manuscripts.³ Suspicions over the paternity of the text were raised by Wadding himself in a 'Censura' that serves as a preface to the text. Wadding chose to include the text in his edition based on the testimony of John Pits (Johannes Pitseus, 1550–1616), who attributed to Duns Scotus a book on *Meteorologica* ('librum unum') in his literary history of England, based on three Oxford manuscripts.⁴ While unwilling to treat the work as spurious ('licet Scoti esse non dissidam'), Wadding noted three elements that call into question the authenticity of the work: (1) Pits'

³ R.P.F. Joannis Duns Scoti, Doctoris subtilis, Ordinis minorum *Opera omnia* (Lyon, Laurentius Durand, 1639), vol. 3, pp. 1–125 (reprinted in *Opera Omnia*, Paris: L. Vivès, 1891, vol. 4, pp. 1–263).

⁴ Johannes Pitseus, *Relationum historicarum de rebus anglicis* (Paris: R. Thierry & S. Cramoisy, 1619), vol. 1, p. 393.

mention of a ‘librum unum’ could mean that Scotus had written only on the first book of *Meteorologica*, whereas the text treats all four books; (2) the text names Saint Thomas ‘beatus’: Saint Thomas was canonized in 1323, while Scotus died in 1308; (3) the text also cites Thomas Bradwardine’s *Tractatus de proportionibus* of 1328.

Wadding tried to offer ways of mitigating these elements: Pits could have meant a single volume, and not Book I of *Meteorologica*; ‘beatus’ would be a simple sign of respect in use before the canonization of Thomas; and the information on Bradwardine’s life and works could be wrong.

If however one would hold the work to be spurious, Wadding proposed the name of Simon Tunsted (d. 1369), a Minor friar of Norwich who taught in Oxford, reported by the same source, John Pits, to have written a treatise on *Meteorologica*, and who appears to have lived at the right time. We do not know much about Tunsted, and the rest of the Franciscan historians who mention him only repeat Pits’s conclusions. There was little basis for Wadding’s conjecture.

The text published by Wadding is a well-developed commentary in the form of *quaestiones* on all the four books, and its content is manifestly close to that of analogous works from the second half of the fourteenth century. Whoever the author may be, Wadding noted the value and importance of the work: ‘Tractatus porro doctus est, curiosus et perutillis, neque ullum vidi in hoc genere ab antiquis potiori, aut ampliori studio exaratum’.

In spite of Wadding’s clear warnings, the text was attributed to Duns Scotus until the twentieth century. It made its career in seventeenth- and eighteenth-century Scotism, when it was used as the basis for Franciscan courses

on meteorology.⁵ Émile Pluzanski still quotes the text as authentic in his monograph on Duns Scotus from 1887.⁶

1.1.2. Heinrich Suter presented in 1882 a manuscript of the *Questions* of Nicole Oresme from St. Gall and noted for the first time the similarity between Oresme and Scotus (i.e., Pseudo-Scotus).⁷ Oresme is believed to have lectured on *Meteorologica* in Paris sometime in the 1340's.⁸ Suter noted that a big part of the questions asked are 'entirely the same'. This is hardly surprising; the similarity in the titles of the questions holds not only for the relationship between Oresme and Pseudo-Scotus, but also for the entire literature on *Meteorologica* produced in fourteenth-century Paris.

1.1.3. Pierre Duhem has drawn attention to the importance of meteorological literature of the fourteenth century for the development of medieval physics in several of his works. He was also the first scholar to take Wadding's warnings seriously and treat Pseudo-Scotus as apocryphal in a note from 1905.⁹ However, Duhem welcomed Wadding's conjecture regarding the

⁵ See, for instance, Livio Rabesano da Montursio, *Cursus philosophicus ad mentem Doctoris Subtilis Ioannis Duns Scoti pro Tyronibus Scotistis planiori stylo exaratus*, (Venice: N. Pezzanam, 1668), vol. 2, and Alipius Locherer, *Clypeus philosophico-Scotisticus sive cursus philosophicus juxta mentem et doctrinam Johannis Duns Scoti elaboratus* (Viena: J. Erhart 1742), vol. 3.

⁶ É. Pluzanski, *Essai sur la philosophie de Duns Scot* (Paris: Ernest Thorin, 1888), p. 194 *passim*.

⁷ H. Suter, 'Eine bis jetzt unbekannte Schrift des Nic. Oresme', *Historisch-literarische Abteilung der Zeitschrift für Mathematik und Physik* 27 (1882): pp. 121–5.

⁸ Based on W. J. Courtenay, 'The early career of Nicole Oresme', *Isis* (2000): pp. 542–8. For Oresme's works, see O. Weijers, *Le travail intellectuel*, vol. 7, pp. 168–90 and M. Clagett, *Nicole Oresme and the Medieval Geometry of Qualities and Motions* (Madison: University of Wisconsin Press, 1968), pp. 645–6. Courtenay has established that Oresme became Master of Arts in the year 1341–1342.

⁹ 'Sur le *Traité des Météores* faussement attribué à Duns Scot', in *Les origines de la statique*, vol. 1 (Paris, Hermann, 1905), pp. 326–35. Duhem notes at p. 327: 'L'étude de ces *Quatre*

attribution of the work to Simon Tunsted. He also noted the similarity between this text and the Parisian production of Nicole Oresme and Themon Judaeus.¹⁰ Duhem concluded that Pseudo-Scotus must have known Themon Judaeus and that he abbreviated his reasoning at times. Duhem also thought, based on the few extracts given by Suter, that Oresme must have made an abbreviation of Pseudo-Scotus, thus an abbreviation of an abbreviation. Duhem therefore positioned Pseudo-Scotus as an intermediary between Themon and Oresme.

Without giving much evidence, Duhem repeated in a second article from 1910 that Themon's questions are the 'prototype' for Pseudo-Scotus, Oresme and Buridan.¹¹ Duhem's assessment that Pseudo-Scotus had abbreviated Themon is at best an exaggeration, from our reading of both texts (at least in what concerns the first three books, as we will show bellow).

1.1.4. Aleksander Birkenmajer has rectified Duhem's view in a study from 1921. Birkenmajer showed that a great deal of the material from Oresme's Book III is also present in Themon Judaeus's meteorology.¹² He offered a thorough

livres sur les Météores ne révèle aucun détail qui ne se puisse fort bien accorder avec l'hypothèse émise ici par Wadding'.

¹⁰ On Themon (Thimon, Themo), see P. Duhem, 'Thémon le fils du Juif et Léonard de Vinci', *Bulletin italien* VI (1906), pp. 97–124, reprinted in his *Études sur Léonard de Vinci*, vol. 1 (1906), pp. 159–200; *Le Système du monde*, vol. 8, pp. 436–42 and vol. 9, pp. 71–3, 219–23, 313–14; H. Hugonnard-Roche, *L'Œuvre astronomique de Thémon Juif, maître parisien du XIV^e siècle*, (Geneva, Paris: Droz, Mignard, 1973). S. Nagel, 'Astri e passioni dell'anima nel I libro delle *Quaestiones in Meteororum* di Timone', in *Parva Naturalia. Saperi medievali, natura e vita. Atti dell'XI convegno della Società Italiana per lo Studio del Pensiero Medievale* (Macerata, 7-9 dicembre 2001), ed. by C. Cresciani, R. Lambertini, and R. Martorelli Vico (Macerata, Pisa, Roma: Istituti Editoriali e Poligrafici Internazionali, 2004), pp. 261–89.

¹¹ 'Sur les *Meteorologicorum libri quatuor* faussement attribués à Jean Duns Scot', *Archivum Franciscanum Historicum* 3 (1910), p. 629.

¹² *Studja nad Witelonem* (Kraków, Nakładem Polskiej Akademji Umiejętności, 1921), trans. in *Etudes d'histoire des sciences en Pologne* (Wrocław, Warszawa, Kraków, Gdańsk: Zakład narodowy imienia Ossolińskich, wyd. Polskiej Akademii nauk, 1972), pp. 178–239.

analysis of the relationship between Oresme, Albert of Saxony, Pseudo-Scotus and Themon based on a comparison of Book III of each work. Birkenmajer's material suggests that we are dealing with deeply entangled but still different works. Birkenmajer managed to establish a chronology of the works based on the internal evidence that emerged from his analysis of Book III: Oresme would come first (before 1348, when he started his theological studies), Buridan, Albert of Saxony and Pseudo-Scotus are intermediary works (1350's), and Themon comes last (late 1350's).¹³ A future and more thorough textual confrontation of all four books should further test the order proposed by Birkenmajer. Meanwhile there is no reason not to accept it. Regarding the relationship between Albert and Pseudo-Scotus, Birkenmajer maintains that one of them had access to the other and that both had access to Oresme's commentary. In any case, we can retain that these works were taught very close to each other.

1.1.5. Lynn Thorndike reported on the manuscript literature of Pseudo-Scotus and Oresme in 1955.¹⁴ He offered a comparison between the titles of the questions of Oresme and Pseudo-Scotus and concluded that they are different works (infirming Duhem). Concerning the chronology, Thorndike followed Birkenmajer, saying that 'it might seem probable that pseudo-Scotus would go before the *Questions* of Themo'. (In spite of this, Henri Hugonard-Roche's more recent study on Themon still followed Duhem and placed Pseudo-Scotus as posterior to both Themon and Oresme.)¹⁵

Regarding the manuscripts of Pseudo-Scotus, Thorndike reports that five of the seven Oxford manuscripts attribute only the first three books of questions on *Meteorologica* to Duns Scotus; one manuscript of the five (Ms. 35, Oriol Coll., Oxford) attributes the first three books to a 'Scotus Junior' ('secundum Scotum

¹³ For Buridan, see É. Faral, *Jean Buridan, maître ès arts de l'Université de Paris, Extrait de l'Histoire littéraire de la France*, vol. XXVIII, 2^e partie (Paris: Imprimerie nationale, 1940), pp. 87–100. Faral places at least part of the work just before 1358.

¹⁴ L. Thorndike, 'Oresme and Fourteenth-Century Commentaries on *Meteorologica*', *Isis* 45 (1954): pp. 145–52 and 'More Questions on *Meteorologica*', *Isis* 46 (1955): pp. 357–60.

¹⁵ *L'Œuvre astronomique de Thémon Juif*, pp. 39–50.

Juniolem’—this could also refer to a production of the early career of Scotus); the oldest of the five manuscripts (Ms. 80, Magdalen Coll., Oxford) attributes the first three books to a Scotulus (‘secundum Scotulum’), and the fourth book to either an anonymous author or to the same Scotulus (‘Anonymi an eiusdem Scotuli’).¹⁶ All these nicknames suggest that we are dealing with a Scotsman or with an early follower of Scotus.

Birkenmajer added yet another manuscript of Pseudo-Scotus, the only one to be found outside Oxford: Ms. Q. 342 ff. 69ra–130ra of the Amplonian Collection at Erfurt (UB Erfurt, Dep. Erf. CA. 4° 342, incipit: ‘Utrum de impressionibus meteoricis sit scientia tamquam de subiecto’). This ms. was not reported in Schum’s catalogue of the Amploniana.¹⁷ Birkenmajer’s report on it suggests that this manuscript is more trustworthy than the Oxford ones: it correctly presents questions 4 and 5 of Book III as separate, whereas they are collated by Wadding, who worked only with two of the Oxford manuscripts.

1.1.6. Concerning the authorship of Pseudo-Scotus, Birkenmajer perused Denifle and Chatelain’s *Chartularium* and found one author that fits the desired decade and name, a Johannes (de Plebis) Scotus.¹⁸ Unfortunately there is no other information regarding this master that can corroborate Birkenmajer’s hypothesis.

¹⁶ L. Thorndike, ‘Oresme and Fourteenth-Century Commentaries on Meteorologica’. Thorndike is reading the descriptions from Coxe (H.O. Coxe, *Catalogus codicum mss. qui in collegiis aulisque Oxoniensibus hodie adservantur*, 2 vols., Oxford: e Typographeo academico, 1852).

¹⁷ A. Birkenmajer, *Études d’histoire des sciences en Pologne*, p. 228. W. Schum, *Beschreibendes Verzeichniss der Amplonianischen Handschriften-Sammlung zu Erfurt*, (Berlin: Weidmannsche Buchhandlung, 1887, reprinted Hildesheim: G. Olms, 2010). The description of this ms. is now to be found in a preliminary version of Brigitte Pfeil’s revision of Schum, dated October 01, 2011, edited by the Digitale Bibliothek Thüringen, URN: urn:nbn:de:gbv:547–201100552 (URL: <http://www.db-thueringen.de/servlets/DocumentServlet?id=19048>, accessed in January 2014).

¹⁸ A. Birkenmajer, *Études d’histoire des sciences en Pologne*, p. 233, n. 221. *Auctarium chartularii Universitatis Parisiensis*, ed. by H. Denifle and É. Chatelain (Paris: Delalain, Didier, 1894–1964), vol. 1, coll. 161.

The nickname *Scotulus* could also have been used to designate a Scottish person of lesser standing than the Subtle Doctor, or simply to designate an abbreviation of a work by Scotus. In any case, they are common among the early Scotists. Pietro de Aquila (d. 1361), who was no Scotsman, was also called *Scotulus* or *Scotellus* and could be a candidate; Antonius Andreae also went by *Scotulus* or *Scotellus* (but he lived too early to be a candidate, ca. 1280–ca. 1335?).¹⁹ We have no further indications.

With the exception of Birkenmajer, most of the scholarship written since Duhem has retained the name of Simon Tunsted, proposed by Wadding, for the text of Pseudo-Scotus, in spite of the lack of any evidence supporting this attribution. Even Thorndike retained the name of Tunsted, although he was reading Brikenmajer. Hugonnard-Roche too compared the astrology of Themon with that of ‘Tunsted’.

The Tunsted hypothesis was definitely laid to rest by Louis-Jacques Bataillon in 1976, who recovered Tunsted’s real questions on *Meteorologica* in Ms. Digby 153, fol. 28r–65v.²⁰ Bataillon concludes that ‘les comparaisons que l’on peut faire entre les deux textes [i.e., Tunsted and Pseudo-Scotus] ne révèlent aucune parenté, au contraire.’ Pseudo-Scotus reverted to anonymity.

1.1.7. Themon Judaeus’s questions on *Meteorologica* were published several times and enjoyed a far-reaching popularity up to the seventeenth century.

¹⁹ On the early Scotists, including Andreae, see C. Bérubé, ‘La première école scotiste’, in *Preuves et raisons à l’Université de Paris. Logique, ontologie et théologie au XIV^e siècle*, ed. by Z. Kaluza and P. Vignaux (Paris: J. Vrin, 1984), p. 9–24. On Aquila and Andreae, see O. Weijers, *Le travail intellectuel*, vol. 7, pp. 128–9 and, respectively, vol. 1, p. 65–6.

²⁰ L.-J. Bataillon, O.P., ‘Le commentaire sur les ‘Météores’ de Simon de Tunstede, O.F.M.’, in *Studies honoring Ignatius Charles Brady, Friar Minor*, ed. by Romano Stephen Almagno, O.F.M. and Conrad L. Harkins, O.F.M. (St. Bonaventure, NY: The Franciscan Institute, 1976), pp. 45–6. P. 55 marks the current *status questionis*: ‘Nous pouvons donc conclure . . . que l’auteur des intéressantes questions imprimées sous le nom de Duns Scot demeure pour le moment dans l’anonymat. Il est à souhaiter que des travaux ultérieurs arrivent à donner un nom à ce maître de valeur.’

There are three known publications that circulated: an incunabulum of *ca.* 1480 from Pavia;²¹ the text bound together with Aristotle's *Meteorologica* and a commentary by Gaetano di Thiene published in Venice in 1496, 1507, 1515, and 1522;²² and George Lokert's (*ca.* 1485–1547) compilation of a complete course on nominalist physics 'ad mentem Parisienses', printed in Paris in 1516, 1517, and 1518, where Themon was published together with Albert of Saxony's *Physics* and *De Coelo*, Buridan's *De anima* and *Parva naturalia*, and Lokert's *On proportions*.²³

On this, we can report that Lokert's edition of Themon, on which Pierre Duhem, Edward Grant and everyone else worked, is missing the first question of the work, 'Utrum de impressionibus meteorologicis sit scientia'—a standard first question to ask in the second half of the century. This question appears in the previous Italian editions and in Ms. Vat. Lat. 2177 held by the Apostolic Library. Lokert's edition is visibly based on a different manuscript than the previous Italian editions: aside from the missing question, there are minor differences in the text.

²¹ Themon Judaeus, *Questiones in Meteorologicam Aristotelis* (Pavia, Antonius de Carcano: *ca.* 1480); Duhem's copy of this work has been made available online by the National Library of Israel.

²² I was able to consult *Gaietanus super Metheo. Habes solertissime lector in hoc codice libros metheororum Aristotelis Stragirite peripatheticorum principis cum commentarijs fidelissimi expositori Gaietani de Thienis: una cum duplici translatione vero Francisci Vatabli & antiqua: nouiter impressos: ac mendis erroribusque purgatos. Tractatum de reactione. Et tractatum de intensione & remissione eiusdem Gaietani. Questiones perspicacissimi philosophi Thimonis super quatuor libros metheororum* (Venice: s.n., 1522), Bibliothèque Mazarine de l'Institut (miscatalogued under the Greek Pyrrhonian Timon of Phlius).

²³ *Questiones et decisiones physicales insignium virorum: Alberti de Saxonia in octo libros physicorum. Tres libros de celo & mundo. Duos lib. de generatione & corruptione. Thimonis in quatuor libros Meteororum Buridani in Aristotelis. Tres lib. de anima Lib. de sensu & sensato Librum de memoria & reminiscencia Librum de somno & vigilia. Lib. de longitudine & breuitate vite Lib. de iuventute & iudicio magistri Georgii Lokert Scoti: a quo sunt tractatus proportionum additi* (Paris: s.n., 1516).

1.1.8. Since Duhem's work on Themon, there has been an important evolution in our knowledge concerning this author: two astronomical disputations by him have been recovered in the Amplonian collection at Erfurt (Ms. F. 313 and F. 380, under Thimon Erfurtensis). They were signalled, although without a description, by Thorndike in 1934, and Hugonnard-Roche edited one of them on the motion of the moon.²⁴ Duhem had lost track of Themon after the latter left Paris with a mission for Pope Innocent VI in 1359. We now know that he ended up in Erfurt in 1350 and that he held these disputations 'apud Schotos', that is, at the Benedictine 'Schottenkloster' of that city (the Abbey of Saint Jacob, founded by Irish and Scottish missionaries).²⁵ Not only that, but he became rector of this school. Could this have favoured the confusion in the manuscripts between Scotus/Scotulus (Pseudo-Scotus) and Themon, teacher of the Scots? Themon reappears again at the Sorbonne, with a career in the Faculty of Arts; his trace is lost in 1371.²⁶

Themon's meteorology appears to be addressed to a Parisian audience, given his geographical references. Hugonnard-Roche dates it after his return from Erfurt, thus with 1350 as *terminus post quem*.²⁷ Birkenmajer dates the work after 1370 (posterior to Pseudo-Scotus, dated by him after 1355).²⁸

1.1.9. On a closer inspection of both Pseudo-Scotus and Themon Judaeus, we can report the following contamination. Pseudo-Scotus as published by Wadding consists in fact of two texts. The first text covers Books I–III of *Meteorologica* and are by an anonymous author (Scotulus in the manuscripts, Pseudo-Scotus). The work bears a resemblance in style and arguments with

²⁴ *A history of magic and experimental science*, vol. 3, pp. 587–8. H. Hugonnard-Roche, *L'Œuvre astronomique de Thémon Juif*.

²⁵ See J. Scholle, *Das Erfurter Schottenkloster* (Düsseldorf: Schwann, 1933).

²⁶ H. Hugonnard-Roche, *L'Œuvre astronomique de Thémon Juif*, pp. 11–23.

²⁷ *L'Œuvre astronomique de Thémon Juif*, p. 39. Themon mentions several times the geography of Paris.

²⁸ A. Birkenmajer, *Études d'histoire des sciences en Pologne*, p. 238.

Themon that does not go beyond that normally found in the *Meteorologica* literature of the time. The second text, covering part of Book IV, is a copy of questions 1 to 4 of Themon Judaeus's Book IV. They are different copies of the same text, as shown by the small variations of words. The Wadding text ends Book IV in the middle of Themon's q. 4 (*Utrum digestio sanguinis et nascentia a calori naturali sit pepansis*), interrupting a sentence. A note in Wadding tells us that some text appears to be missing ('*Aliqua videntur adhuc deesse*'). Themon's text, as we have it from the Venice and Paris editions, continues the text of Book IV of Pseudo-Scotus with the rest of q. 4, and adds four other questions. Thus Wadding's Pseudo-Scotus added an incomplete copy of Themon's Book IV to a treatise on Books I–III by someone else.

The separation between the two works, that covering Books I–III and that covering Book IV, is confirmed by Thorndike's report on the Oxford manuscripts. According to Thorndike, in Ms. 93, Balliol Coll., the fourth book comes first (96ra–107ra), before Books I–III (108ra–148va), so that the ending of Book III, 'Expliciunt questiones super tres libros metheororum secundum Scotum doctorem subtilem', applies only to the first work (Books I–III).²⁹ Ms. 80, Magdalen Coll. also separates the two texts, but conjectures that Book IV could be by the same Scotulus.

1.2 Doctrinal commentary. Pseudo-Scotus on the object of science

As Thorndike and Kibre have noticed, any collection of questions on *Meteorologica* is susceptible of beginning with 'Utrum de impressionibus

²⁹ 'More Questions on Meteorologica', p. 360.

meteoricis sit scientia (tanquam de subjecto).³⁰ This kind of questions sprung from thirteenth-century discussions on the scientific character of theology and is common as an introduction to a particular science.³¹ The lectures of Buridan, Oresme, Themon, Albert of Saxony or Pseudo-Scotus all begin with this question (with some variations) and cover the scope of meteorology, its subject matter as distinct from that of other natural philosophical disciplines, and its status as an Aristotelian demonstrative *scientia*. The exposition concludes with remarks on the probable character of meteorology, owing to the instability of meteorological bodies: meteorology is a science that, although it strives for the ideal of an Aristotelian demonstrative science, can only attain it partially.

Fourteenth-century texts usually mention in this context the much-debated issue of the object of scientific knowledge developed on both sides of the English Channel from the 1320's onwards. The main rival epistemological theories concerning the object of science are known in the current literature: is the object the *conclusion* of a syllogism, is it the *thing* in itself, or is it the *total significate* of the conclusive proposition (*significabile complexe*)? In spite of having received considerable attention from scholars, there is still much ground to be covered in this dossier. The transmission of these ideas from Oxford to Paris remains little known and there are many unanswered questions concerning the paternity of particular arguments and their circulation from one master to another. Much of the filiations traced so far remain provisional, waiting for advancements from textual criticism. With this caveat noted, the presentation of Pseudo-Scotus's treatment of the object of meteorology will allow us to shed more light on what I believe to be the common opinion held in Paris in the second half of the century, a position developed as a result of the rejection of Gregory of Rimini's notion of the adequate significate of a proposition. The Parisian masters, from Buridan to Pseudo-Scotus, Themon and up to Marsilius of Inghen, maintain the following position: the *conclusion* of the demonstration is the immediate object of scientific

³⁰ L. Thorndike and P. Kibre, *A Catalogue of Incipits of Medieval Scientific Writings in Latin* (London: The Medieval Academy of America, 1963), p. 1640.

³¹ See M.-D. Chenu, *La théologie comme science au XIII^e siècle* (Paris: J. Vrin, 1943).

knowledge, the *terms* of the conclusion are the remote object, and the *things* signified by those terms are the final, but most important, object. I take this opinion to be a development of Ockham himself, mediated by Buridan's reading. Pseudo-Scotus, who presents, often in an abbreviated form, the main of the arguments of this debate, is, in this context, a valuable witness of the development of Parisian nominalism.

1.2.1 Meteorology as an Aristotelian *scientia*

The answer to the literal question, 'is there a [proper, Aristotelian] science of the meteors', is far from mysterious and all authors will arrive at a positive conclusion. The question had its tradition in the Paris curriculum before the import of the views on the object of scientific knowledge from Oxford. Siger of Brabant's discussion from the thirteenth century ('*utrum de impressionibus possit esse scientia*') offers a summary of the material inherited by fourteenth-century authors. Siger argued from a strictly Aristotelian perspective: the subject of meteorology is universal, incorruptible, real and not faked. Most importantly, meteors have properties (*passiones*), and something that has properties can be scientifically investigated by deriving those properties from known principles. Therefore, a science of meteorological phenomena is possible, answered Siger, even though these phenomena are ephemeral and most of the time lack present existence.³²

Pseudo-Scotus recites this same view:

Prima [conclusio] est, quod de impressionibus Meteoricis est scientia, tanquam de obiectis. Probatur, quia tales impressio-

³² Siger's questions on meteorology are unedited, but F. Van Steenberghen, *Siger de Brabant d'après ses œuvres inédites*, 2 vols. (Leuven: Éditions de l'Institut supérieur de philosophie, 1931–1942), vol. 1, p. 233, provides a summary of Siger's solution.

nes habent causas determinatas, proprias passiones, et principia, per quae istae passiones possunt de iis demonstrari.³³

This is one side of the answer that will endure through the fourteenth-century literature: meteorology is an Aristotelian demonstrative science as established by the *Posterior Analytics*. It does not come without arguing. A first series of *contra* arguments, seeking to show the epistemological weakness of meteorology, revolve around probability and certitude. (1) It is claimed that one can only arrive at insecure notions or at mere opinions regarding the meteors ('notitia cum formidine ad oppositum' is the technical term, a notion with fear that the opposite may also be true).³⁴ The limits of meteorology as a demonstrative science are usually admitted here. Pseudo-Scotus will concede that about certain meteors, such as the comets and the Milky Way, we can only have opinions, and not *scientia*. But, he adds, there are only a very limited number of such phenomena; about most meteors 'we have true notions'. Nevertheless, he notes that we cannot attain in natural science the kind of certitude we can have in mathematics or optics (one can invoke in support of this view a famous passage from Aristotle, *Met.* α, 3, 995a 14–16).³⁵ Themon is even more pessimistic on this point, considering that Aristotle's *Meteorologica* books are but an aggregate of a

³³ Pseudo-Scotus, *In I Meteor.*, q. 1, ed. Wadding, p. 3a.

³⁴ 'Arguitur quod non, quia de impressionibus solum habetur notitia cum formidine ad oppositum; ergo, etc'. Cf. Themon, *In I Meteor.*, q. 1, ed. 1522, p. 87a: 'Queritur primo utrum de impressionibus meteorologicis sit scientia. Et arguitur primo quod non, quia de omnibus impressionibus est solum vaticinium coniectura et divinatio vel opinio: ergo de illibus non est scientia. Consequentia patet, quia scientia est habitus certus omnibus demonstrate sine formidine.' (Ibid., p. 3a).

³⁵ '... concedo quod quantum ad aliqua, quae demonstrantur in ista scientia, solum habetur notitia cum formidine ad oppositum, sicut de Cometis, Galaxia; sed de aliis vera habetur notitia, et conclusio ad tertium librum licet non habeatur notitia ita certa, sicut in Mathematica et perspectiva.' (Ibid., p. 8a).

few proper demonstrations amidst many opinions and conjectures.³⁶ (2) Interestingly though, the probabilism attested by the previous argument is counter-balanced by another *contra* argument. Meteorology depends heavily on empirical observations; the experience of the senses that testify of meteorological phenomena is far more secure than any scientific notion we can have, given the infirmity of our intellect in our current state. The generally shared principle invoked is *experientia sensus est notita dignior quam scientia*. But Aristotelian science does not consist solely of pure observations, answers Pseudo-Scotus. Empiricism, by its own, does not yield an Aristotelian science, which consists instead in the *interpretation* of the experiences gathered. We are to add, according to Pseudo-Scotus, a ‘scientific notion’ to the experience of the senses, by searching for the proper causes of those experiences, as Aristotle teaches.³⁷

Another series of *contra* arguments is drawn from the specific character of the material that meteorology deals with. (3) The ephemeral status of the meteors, already encountered in Siger, suggests that there can be no knowledge of things that are not present when the knowledge is acquired—e.g., lightning, thunder, or the rainbow. About these, Pseudo-Scotus holds that we will have a ‘provisional science’ (*scientia conditionalis*) that remains to be verified, and not a proper affirmative demonstrative science.³⁸ (4) A classical argument is taken from the inordinate character of meteorological phenomena, to which Pseudo-Scotus will devote a long separate question: meteors appear to arise from violent motions, they are produced *against nature* and they are impossible to predict.³⁹ Buridan and Themon also give a variation of this argument: meteorological phenomena

³⁶ Themon, *In I Meteor.*, q. 1, ed. 1522, p. 87c.

³⁷ ‘Nam quantum ad quod est huiusmodi impressionum habemus experientiam sensus, et scientifice inquirimus causas ipsarum.’ (Pseudo-Scotus, p. 8a).

³⁸ ‘Ad quartam [quia huiusmodi impressiones, ut in presentibus non sunt, sicut patet de tonitru, fulmine, iride, et huiusmodi], dico quod quaecumque non sunt huiusmodi impressiones, de iis est solum scientia conditionalis, et non categorica affirmativa demonstratio.’ (Pseudo-Scotus, p. 8a).

³⁹ *In I Meteor.*, q. 2, ‘An impressiones Meteoricae fiant per naturam inordinationem ea natura, quae est propria elementorum?’

happen *a casu vel a fortuna*, whereas science is about necessary phenomena (*scientia est de necessariis*).⁴⁰ Pseudo-Scotus insists on the *order* of production, which is necessary for any science looking for causes of phenomena: if the order is changed, the science acquired on the basis of the old order of phenomena will be thereby falsified (*mutato ordine, mutabitur, sive falsificatur scientia*). The answer returns to the mixed character of meteorology: some meteors are generated violently (e.g., thunder strike is not part of the natural inclination of fire), while some are generated naturally (rain drops arise because of gravity, a natural inclination of water). But all meteors, even the violently generated ones, are part of the general order of creation just like any other body of the universe, although their motions are more difficult to discern than the motion of celestial bodies. There is less order in the meteors, but less order does not mean no order at all.⁴¹

1.2.2 The nominalist challenge

The basis for considering meteorology an Aristotelian demonstrative science being laid, we are now faced with epistemological issues that apply to all sciences. To this predictable set of arguments, Pseudo-Scotus adds a new problematic drawn from the Ockhamist tradition. It is said by others, reports Pseudo-Scotus, that the meteors cannot make the object of science because they are things outside of the mind (*res extra animam*). We recognize the basis of this objection in the Ockhamist notion that science deals with mental discourse. The

⁴⁰ Buridan, *In 1 Meteor.*, q. 1, 1, ed. Bages, p. 3: ‘Item de causalibus et fortuitis non est scientia, 20 Physicorum [*Physics*, II, 5]. Hec autem sunt casualia et fortuita quia extra semper et frequenter, ut tonitrua, fulmina, motus terre, stelle comete, ergo.’ Themon, ed. 1522, p. 87a: ‘Impressiones fiunt a casu vel a fortuna . . . consequentia tenet: quia scientia est de necessariis quod non possunt aliter se habere: sed casualia et fortuita possunt aliter se habere.’

⁴¹ Pseudo-Scotus, *In 1 Meteor.*, q. 2, pp. 8b–13a.

reason why things outside of the mind cannot be the subject of proper science is that in this way, one and the same thing can become the object of science, belief and opinion *at the same time (eadem ratione)*: for instance, about God we can know that He exists and at the same time doubt that He is one and believe that he is trine:

Sexto, quia si res extra animam esset objectum scientiae, eadem ratione esset credulitatis, quia idem videtur iudicium de utroque. Consequens est falsum, nam tunc idem simul et semel posset sciri, opinari et credi; et ita posset de eodem error esse et ignorantia. Sicut, verbi gratia, de Deo possumus scire ipsum esse, et dubitare ipsum esse unum, et credere ipsum esse trinum.⁴²

This argument had been made by Gregory of Rimini in the Prologue of his *Sentences* on behalf of Ockham:

Secundo, si res esset obiectum scientiae totale, ut nunc de obiecto loquimur, eadem ratione res extra esset obiectum opinionis et fidei et erroris, et per consequens contingeret quod idem homo idem sciret et opinaretur et crederet et etiam ignoraret ignorantia dispositionis quae error nominatur; quae omnia sunt absurda. Patet consequentia, nam contingit eundem scire quod deus est aeternus, opinari quod solus et immediate moveat coelum, credere quod sit trinus in personis, errare putans quod sit in vigore finitus.⁴³

⁴² Ibid., p. 3b–4a.

⁴³ Gregory of Rimini, *In I Sent.*, prol., q. 1, in *Lectura super primum et secundum Sententiarum*, vol. 1, ed. by A.D. Trapp and V. Marcolino (Berlin, New York: Walter de

The argument shows that the distinction between the intellectual acts of scientific knowledge, faith, and opinion needs a distinction between their objects. The argument, as far as I understand it, does not claim that the singular thing is not the object of science, faith, and opinion, but that something more besides the singular thing of the world must be posited in order to distinguish these intellectual acts.

We are now inside the vaster nominalist problematic on what is the proper object attained by scientific knowledge. The different theories on this matter are usually mentioned at this point in the corresponding texts of the other Parisian masters mentioned in this essay, but Pseudo-Scotus's treatment is by far the most extended and thorough. He reports on the main arguments developed, discusses Gregory's theory of a *significabile complexe* as the object of science and lays down his own view. Buridan, for instance, does not mention the theory of the *significabile complexe* in this place, while his critique of Gregory on this point is well known from other places in his corpus.⁴⁴ Buridan goes straight to the solution, without arguing: there are three objects of science, the demonstrated conclusion, the terms that compose the conclusive sentence and the things signified by the terms.⁴⁵ Themon, for his part, argues briefly that just as the sensible things are the ultimate object of sensation, so the things outside of the

Gruyter, 1981), p. 7, 1–7. See, for the origins of the argument, M. Grabmann, 'De quaestione 'utrum aliquid possit esse simul creditum et scitum' inter scholas augustissimi et aristotelico-thomismi medii aevi agitata', in *Acta hebdomadae augustinianae-thomisticae* (Turin, Rome: Marietti, 1931), pp. 110–39.

⁴⁴ On Buridan's refutation of Gregory, see J. Biard, 'Les controverses sur l'objet du savoir et les 'complexe significabilia' à Paris au XIV^e siècle', in *Quia inter doctores est magna dissensio. Les débats de philosophie naturelle à Paris au XIV^e siècle* (Florence: Olschki, 2004), ed. by S. Caroti and J. Celeyrette, pp. 1–31.

⁴⁵ Buridan, *In I Meteor.*, q. 1, ed. Bages, p. 5.

mind are the ultimate object of scientific knowledge, on the basis of the principle *sicut in sensu, ita et in intellectu*.⁴⁶

Let me briefly recall here the main traits of the epistemological debate on which Pseudo-Scotus takes position. This discussion has been brought to scholarly attention by Hubert Élie's pioneering study on Gregory's notion of the *complexe significabile* (1936).⁴⁷ Our historical representation of it has suffered a number of revisions since then, the most important of which is the attribution of the theory to Adam Wodeham rather than Gregory, by Gedeon Gál, in 1977.⁴⁸ As far as historians of medieval logic are concerned, the problem of the object of scientific knowledge is a question of the bearer of truth and falsity (is it the proposition which carries that function, is it the *res extra*, or is it the total significate of the proposition, the *significabile complexe*?).⁴⁹ The discussion is

⁴⁶ 'Prima conclusio: quod impressiones meteorologice sunt obiectum ultimum notitie scientificae que est de ipsis. Probat, quia res sensibiles sunt obiectum ultimum sensitivarum notitiarum et non species sensibiles nec complexe significabile nec aliquid aliud . . . sicut in sensu, ita et in intellectu.' (Themon, *In I Meteor.*, q. 1, ed. 1522, p. 87).

⁴⁷ *Le complexe significabile* (Paris: J. Vrin, 1936), reedited as *Le Signifiable par complexe. La proposition et son objet. Grégoire de Rimini, Meinong, Russell* (Paris: J. Vrin, 2000).

⁴⁸ G. Gál, 'Adam of Wodeham's question on the 'complexe significabile' as the immediate object of scientific knowledge', *Franciscan Studies* 37 (1977): pp. 66–102. Among the bibliography devoted to the subject: P. Vignaux, 'La problématique du nominalisme médiéval peut-elle éclairer des problèmes philosophiques actuels?' *Revue philosophique de Louvain* 75 (1977): pp. 293–331, puts the notion into perspective, as does A. de Libera, *La référence vide*; G. Nuchelmans, *Theories of the proposition. Ancient and medieval conceptions of the bearers of truth and falsity* (Amsterdam, London: North-Holland, 1973) discusses the panorama of views; E.J. Ashworth, 'Theories of the proposition: some early sixteenth-century discussions', *Franciscan Studies* 38 (1978), pp. 81–121, reprinted in *Studies in post-medieval semantics* (London: Variorum, 1985), presents the aftermath in the sixteenth century; texts belonging to this discussion are gathered in D. Perler, *Satztheorien: Texte zur Sprachphilosophie und Wissenschaftstheorie im 14. Jahrhundert* (Darmstadt: Wissenschaftliche Buchgesellschaft, 1990); J. Biard, 'Les controverses sur l'objet du savoir', offers a good summary.

⁴⁹ According to E.J. Ashworth, 'Theories of the Propositions: Some Early Sixteenth-Century Discussions', there is a cluster of three questions at stake: the question over the object of

initially developed in the theological literature over the *Sentences*, where it was important to determine the differences between the subject of science and that of faith, in order to clarify the distinction between the two disciplines ('Utrum theologia sit scientia una de Deo tamquam de subjecto').⁵⁰ But soon enough, the epistemological question invades all disciplines: logic, physics, metaphysics, and, as we have seen, even meteorology. In doing so, it carries along with it the cognitive discussion over the relationship between the intellectual act of knowing, the object of knowledge and the real objects of the world specific to fourteenth-century nominalism, and measures it against the requirements of an Aristotelian demonstrative *scientia* codified by the *Posterior Analytics*. Thus an answer to this question aims at securing, ultimately, the inherited notion of *scientia*: how can we attain a science of necessary and unchanging things by grasping only a limited number of particular things—or not even those, but merely their *signs*?⁵¹ Briefly put, in terms of a long durational historiography, the challenge facing the Parisians was how to maintain the Aristotelian understanding of *scientia* after the Ockhamist linguistic turn.

The beginnings of this discussion are situated in late 1320's–early 1330's Oxford, in the debates surrounding Ockham's epistemology. The question is still 'what is the subject of this science (*tanquam de subjecto*)?' The thirteenth-century vocabulary distinguished between the *esse subjectivum* of the *res* in itself and the *esse objectivum* of the *res* before the mind. The *subject* of a science is the material it deals with (e.g., the mobile body, the imperfect mixtures, and the meteors; for the Ockhamist, this will be the term that has the function of grammatical subject in the sentence that concludes the demonstration). The *object* of a science is that in which the intellectual act of knowing terminates, in the sense in which we speak

scientific knowledge, the question over the bearer of truth and falsity, and the question over what is the significate of a proposition. One answer should satisfy all three.

⁵⁰ There are more precise theological roots of the discussion, some of which are discussed by Nuchelmans, *Theories of the proposition*, pp. 177–94 (on theological arguments leading up to Ockham and Holkot's *complexum* theory).

⁵¹ Élie asks at p. 15: 'Le *Venerabilis Inceptor* se doutait-il qu'il allumait ainsi un incendie qui allait durer jusqu'à la fin du moyen âge?'

of objects of the senses as that which the senses touch.⁵² Although there is a fluctuation of the terms *subjectum* and *objectum scientiae* in the literature, and they are often used indiscriminately, it is the object that we are looking for: *illud quod scitur*, that which terminates the act of knowing. For Ockham, the *immediate* object of science is the propositional content at which it arrives, that is, the *conclusions* of the scientific demonstrations. A conclusion is a proposition, called a *complexum* or *complexum mentale*; it is complex because it is composed of simple terms; it is also mental because it is independent of its vocal utterance.⁵³ Against this Ockhamist position, his critic, William Chatton, raised an important and far-reaching objection: knowledge and faith had better attain the things in themselves, not some mental construct. Faith in God should aim at God, not at a proposition. Therefore, Chatton held, against Ockham, that both the act of knowing and the act of assenting have the things outside of the mind as their object, and not the ‘complex signification of the thing outside of the mind’.

⁵² See L. Dewan, ‘*Obiectum*: Notes on the Invention of a Word’, *Archives d'Histoire Doctrinale et Littéraire du Moyen Age* 48 (1981): pp. 37–96.

⁵³ See Ockham, *In I Sent.*, prol., q. 9 in *Opera theologica* (Saint Bonaventure, NY: The Franciscan Institute, 1967), vol. 1, p. 266 and *Expositio in lib. phys. Aristotelis*, prol., §3 in *Opera philosophica* (Saint Bonaventure, NY: The Franciscan Institute, 1985), vol. 4, p. 9: ‘Nam obiectum scientiae est tota propositio nota, subiectum est pars illius propositionis, scilicet terminus subiectus. Sicut scientiae qua scio quod omnis homo est susceptibilis disciplinae, obiectum est tota propositio, sed subiectum est iste terminus “homo”’. It would be tedious to send the reader to the numerous commentators of this view; for Ockham’s conception of science, I rely mostly on R. Guelluy, *Philosophie et théologie chez Guillaume d'Ockham* (Louvain: Nauwelaerts and Paris: J. Vrin, 1947), still valid, who comments closely the Prologue of the *Ordinatio*; for his epistemology, on C. Michon, *Nominalisme: La théorie de la signification d'Occam* (Paris: J. Vrin, 1994) and C. Panaccio, *Le discours intérieur: de Platon à Guillaume d'Ockham* (Paris: Seuil, 1999); Ockham’s evolution on the issue of the ontological status of mental concepts, known to Ockhamist scholarship, does not concern the present discussion.

Chatton's critique of Ockham became known in Paris probably through Adam Wodeham and Gregory of Rimini.⁵⁴

The initial Oxford debate was thus whether the object of science is the *res extra* or the *signa*, the *res significata* or the *complexum significationis*. We recognize here the question posed by Pseudo-Scotus on whether science attains the *res extra animam* mentioned earlier. Between these two alternatives, a third alternative was developed by Adam Wodeham and championed on the continent by Gregory of Rimini, who commented on the *Sentences* in 1343–1344.⁵⁵ Although Adam is now believed to have been the initiator of the theory, I will insist on Gregory, who was the primary source for the Parisian discussion and was followed closely by Pseudo-Scotus. The view put forward by Adam and Gregory is that the signification of a proposition is distinct from both the material sentence (i.e., from

⁵⁴ I only summarize the main points of the more developed Oxford discussion; see G. Nuchelmans, *Theories of the proposition*, pp. 195–225; K. Tachau, 'Wodeham, Crathorn and Holcot: The development of the *complexe signifiabile*', in *Logos and Pragma. Essays in honour of Professor Gabriel Nuchelmans*, ed. by L.M. de Rijk and H.A.G. Braakhuis (Nijmegen, 1987), pp. 161–87 and *Vision and Certitude in the Age of Ockham: Optics, Epistemology, and the Foundations of Semantics, 1250–1345* (Leiden: E.J. Brill, 1988), pp. 202–8; J. Biard, 'Les controverses sur l'objet du savoir', pp. 2–8, for the Oxford debate between Ockham, Holcot, Chatton, Crathorn and Burley.

⁵⁵ See Adam's text edited by Gál, 'Adam of Wodeham's question on the 'complexe significabile' as the immediate object of scientific knowledge'; now in the edition of Adam's *Lectura secunda in Librum primum Sententiarum*, ed. by R. Wood and G. Gál (Saint Bonaventure, NY: The Franciscan Institute, 1990), vol. 1, pp. 180–98. On Gregory, see G. Leff, *Gregory of Rimini. Tradition and Innovation in Fourteenth-Century Thought* (Manchester: Manchester University Press, 1961); on his career, see V. Marcolino, 'Der Augustinertheologe an der Universitaet Paris', in *Gregor von Rimini. Werk und wirkung bis zur Reformation*, ed. by H.A. Oberman (Berlin: W. de Gruyter, 1981), pp. 127–94; on his theory, see P. Bermon, *L'assentiment et son objet chez Grégoire de Rimini* (Paris: J. Vrin, 2007), who provides a recent and extended commentary. Cf. also M. Del Pra, 'La teoria del significato totale della proposizione nel pensiero di Gregorio da Rimini', *Rivista critica di storia della filosofia* 11 (1956): pp. 287–311 and V. Wendland, 'Die Wissenschaftslehre Gregors von Rimini in der Diskussion', in *Gregor von Rimini. Werk und wirkung bis zur Reformation*, pp. 242–300.

the terms that compose the sentence) and from the things signified by the sentence. It is the *significatum totale* or *adaequatum* of the sentence that which makes the object of scientific knowledge.⁵⁶ Assent cannot be given to the proposition alone, argued Gregory, against Ockham: it can only be given to the *fact* that the proposition is in agreement with the signified things as they are in the world. The total and adequate signification of the proposition ‘Deus est’ is ‘Deum esse’, the fact that God is. These total and adequate significations are true or false even if there is no sentence uttered to signify them (*Deum esse* does not cease to be true once the sentence has been said), and so they are called *significabiles* or *enuntiabiles*. They are also called *complex*, for they require a sentence in order to be signified, a *complexum* of terms. In simple speech, the technical term *significabile complexe* stands for the significate of a proposition.⁵⁷

Thus, Pseudo-Scotus inherits from this discussion three *viae*: according to one *via*, the subject of science is the known conclusion (this is labelled as the Ockhamist position by Gregory; but it is rather the Ockhamist position as critiqued by Chatton, or Holkot’s position);⁵⁸ another *via* is that of the *significabile complexe* (Adam Wodeham and Gregory of Rimini); and a third *via* is that of the things signified through the terms of the known conclusions (Chatton’s view).⁵⁹ This is a *status questionis* on which an author was supposed to

⁵⁶ ‘Nec conclusio demonstrationis, nec res aliqua est obiectum, sed significatum adaequatum conclusionis.’ (Gregory, *In I Sent.* prol. q. 1, ed. Trapp–Marcolino, p. 12).

⁵⁷ For the prehistory of these terms, see P. Bermon, *L’assentiment et son objet*, pp. 117–25.

⁵⁸ See H. Schepers, ‘Holkot contra dicta Crathorn, II: Das ‘significatum per propositionem’. Aufbau und Kritik einer nomanilistischen Theorie ueber den Gegenstand des Wissens’, *Philosophisches Jahrbuch* 79 (1972): pp. 106–36 and M. dal Pra, ‘La proposizione come oggetto della conoscenza nel pensiero di Roberto Holcot’, in *Logica e realtà: momenti del pensiero medievale* (Bari: Laterza, 1974): pp. 83–119.

⁵⁹ ‘In ista quaestione videbitur secundum viam triplicem, quid est subjectum scientiae . . . Est una via quae ponit subjectum scientiae est ipsa conclusio scita . . . Alia via est, quod obiectum scientiae est significabile complexe per conclusionem scitam . . . Pro tertia via sit conclusio ista: Res significatae per terminos conclusionis scitate sunt obiecta scientiae.’ (*In I Meteor.*, q. 1, 4–5).

give his opinion. After exposing the arguments, mainly based on Gregory, Pseudo-Scotus arrives at what he takes to be a reconciliatory position, for there is a sense in which all these three alternatives can be said to be the object of science.

Pseudo-Scotus seems to be very much aware of Gregory of Rimini's arguments: he uses his arguments when exposing the problem, but he argues nevertheless *against* Gregory's position, in the same camp with Buridan. Chronologically, Pseudo-Scotus should have had direct access to both these authors, but it is safer to assume that he was drawing from a common pool of known arguments. The fact that Pseudo-Scotus reports what appears to be an abbreviation of Gregory's arguments testifies to the deep influence that Gregory had in the Parisian milieu.

1.2.3 Refutation of the 'Ockhamist' position

Whether conclusions are the object of scientific knowledge or not, it is argued for as follows, according to Pseudo-Scotus.

(1) The first *via* argues that truth and falsity can only be applied to propositions, not to things in themselves. Things in themselves cannot be qualified as true or false; on the contrary, a demonstrative scientific conclusion can only be derived from *true* propositions. If science is about *true* things, on the basis of the principle *nihil scitur nisi verum*, then only propositions can be true.

The refutation provided attacks the principle *nihil scitur nisi verum*: Pseudo-Scotus maintains that one can know things without qualifying them as

true or false.⁶⁰ Gregory had made the same point on behalf of Ockham (via Adam, via Chatton).⁶¹

(2) A second argument claims directly that a general science of singular things is impossible. Science works with universal notions; the object of universal science can be a) a universal conclusion, q.e.d. b) a universal, but they do not exist, or c) the singular thing signified by the conclusion. Singular things however cannot make the object of universal notions: there is no reason to consider *this* particular triangle as the object of the universal notion of ‘triangle’ rather than *that* particular triangle. Once again, Pseudo-Scotus is drawing on Gregory.⁶² Unlike Gregory though, who can oppose to this argument the theory of the *significabile complexe* as the proper object of universal science, Pseudo-Scotus replies with a traditional view: the object of universal conclusions are indeed all singular things to which that conclusion applies, singular things of which the

⁶⁰ ‘Nihil scitur nisi verum; nam omnis demonstratio est ex veris, ut patet per Aristotelem primo Posteriorum: sed sola propositio est vera; ergo sola propositio scitur, et non alia, quam conclusio; igitur, etc.’ (*In I Meteor.*, q. 1, p. 4a). ‘Apertum est quod nihil scitur nisi verum, tanquam conclusio scita, tamen aliquid scitur verum, tanquam res significata per subiectum conclusionis scitae, quando tum neque est verum, nec falsum.’ (Ibid., p. 6b).

⁶¹ ‘Prima [ratio] est, quoniam nihil scitur nisi verum, sola autem propositio est vera, igitur sola propositio scitur, et non nisi conclusio. Igitur, etc.’ (Gregory, *In I Sent.*, prol., q. 1, a. 1). See Ockham’s treatment of this principle from *In I Sent.*, d. 2, q. 4, in *Opera theologica*, vol. 2, pp. 135–40.

⁶² Pseudo-Scotus, *In I Meteor.*, q. 1, 2: ‘Secundo, quia obiectum scientiae universale vel est ipsa conclusio universalis, et habetur intentum; vel est ipsa res signata per terminos istius conclusionis, et tunc vel res universalis, et hoc non, cum nulla talis sit; vel res singularis, et hoc non, quia qua ratione una res singularis est obiectum istius notitiae, eadem ratione alia, et per consequens nulla res est obiectum istius.’ Gregory, *In I Sent.*, prol., q. 1, a. 1: ‘Secundo, obiectum scientiae demonstrationis universalis est conclusio illius demonstrationis, igitur et cuiuslibet scientiae per demonstrationem acquisitae obiectum est conclusio demonstrationis illius. Assumptum probatur, quia vel ipsa conclusio universalis est obiectum illius scientiae, et habetur propositum, vel res extra animam. Sed hoc esse non potest, quia nec res universalis, cum nulla sit huiusmodi, nec res singularis, quia non potius una quam alia significata per subiectum conclusionis [est obiectum].’

universal notion yields a *confused* concept. The universal concept of ‘man’ is caused by a limited number of singular men, and yet, through it, we have a confused concept of all men in the world.⁶³

(3) A third argument for the Ockhamist position is drawn from the knowledge of figments. The object of a known conclusion such as ‘The hircocervus is not a chimera’ cannot be the thing outside of the mind signified by it, because it does not exist; therefore it has to be the proposition itself. The reification of imaginary objects such as chimeras is a position developed initially in Oxford but also taught in Paris, by Marsilius of Inghen for instance. According to this view, the complex concept of a hircocervus is not simply the juxtaposition of the simpler concept of a half-horse with the simpler concept of a half-stag, but something distinct from the two. This is not the view that Pseudo-Scotus follows: he opts for the alternative opinion, associated with Buridan and Albert of Saxony, according to which the object of a chimera is nothing more than the sum of the objects of its components. Consequently, only existing objects signify for Pseudo-Scotus: there is no void reference.⁶⁴

(4) Another argument is drawn from the principle that assent necessarily follows a known true notion. This can lead an Ockhamist to think that the object of a known scientific notion and the object of assent are one and the same (*idem est id quod scimus et id cui assentimus*). If *id quod scimus=id cui assentimus*, we fall back on the previously mentioned case that propositions are the object of

⁶³ ‘Dico quod objectum conclusionis universalis est quaelibet res singularis significata per objectum istius conclusionis, quia quaelibet talis apprehenditur per conclusionem universalem, saltem conceptu confuso.’ (*In I Meteor.*, q. 1, 6).

⁶⁴ ‘Dico quod objectum istius [hircocervi] est caput Draconis, cauda Leonis, corpus Equi, vel sic de hujusmodi’ (*In I Meteor.*, q. 1, 6). See J. Biard, *Logique et théorie du signe au XIV^e siècle* (Paris: J. Vrin, 1989), pp. 229–31, A. de Libera, *La référence vide*, pp. 99–109 and E.J. Ashworth, ‘Chimeras and Imaginary Objects: A Study in Post-Medieval Theory of Signification’, *Vivarium* 15 (1977): pp. 55–79. For the Oxford discussion, see J. Biard, ‘La signification d’objets imaginaires dans quelques textes anglais du XIV^e siècle’, in *The Rise of British Logic*, ed. by P.O. Lewry (Toronto: Pontifical Institute of Medieval Studies, 1983), pp. 265–83.

both, because only propositions can be true, and we assent to what is true. An objector needs therefore to deny the identification between the object of knowledge and the object of assent: we assent to propositions, but we know things.⁶⁵

Two further arguments are laid down that attack the cognitive mechanism of a science of conclusions, both of them drawn from Gregory. (1) If the object of science were the conclusion, it would follow that one has a reflexive act accompanying one's act of knowing every time one knows something. However, such a reflexive act applied to what we know is very rare, and most of our scientific knowledge does not terminate in a reflection over what we have come to know, but in the things signified.⁶⁶ (2) Admitting that the conclusive sentence is the object of knowledge and is apprehended by the intellect, one asks: is this apprehension complex or simple (*incomplex*)? Scientific knowledge cannot be obtained solely from simple apprehensions of singulars, for *scientia* does not satisfy itself with pure empiricism. On the contrary, scientific knowledge joins evident principles or predetermined knowledge with simple apprehensions. We cannot be dealing with *complex apprehensions* either: a complex apprehension grasps a proposition together with its relationship to the signified things and judges their conformity to one another; that means that the complex apprehension intrinsically bears a truth value (*apprehensio iudiciaria* is Gregory's term). That would automatically make the conclusion true, which is more than we

⁶⁵ 'Negatur, quia illud scimus tanquam objectum scientiae, quod significatur per partes illius cui assentimus.' (*In I Meteor.*, q. 1, 6).

⁶⁶ 'Contra istam opinionem opponitur, quia si conclusio esset objectum scientiae habitae per conclusionem, sequeretur quod quilibet actu sciens haberet actu cognoscendi conclusionem. Consequens falsum, quia nunquam, vel raro habemus actum reflexum super nostram cognitionem, quamvis saepe cognoscamus.' (*In I Meteor.*, q. 1, 3). Cf. Gregory, *In I Sent.* prol. q. 1, a. 1, p. 4, 7–15: 'Nam plerumque, immo quasi semper contingit quod demonstrans, quamvis formet conclusionem, non tamen actu reflectitur super illam apprehendendo ipsam, sed directe figit suum aspectum in id, quod ipsa significat.'

want: we know in fact many conclusions without knowing their conformity with things, such as the conclusions of geometrical demonstrations.⁶⁷

1.2.4 The *significabile complexe* and the eternal truths

The second way reported by Pseudo-Scotus argues that the object of the proposition ‘Man is able to laugh’ (*Homo est risibilis*) is neither man, nor laughter, but the ‘state of affairs’ of ‘man being able to laugh’ (*Hominem esse risibilem*). This is Gregory’s position. The main argument for the *significabile complexe* relies on the already encountered analogy between sensorial knowledge and scientific knowledge: when I feel hot fire, through this experience I know not only fire and not only hotness, but I know the fact that fire is hot (*ignem esse calidum*).⁶⁸ The knowledge of the centre of the circle to which the geometer

⁶⁷ ‘Secundo, si conclusio esset objectum, tunc conclusio apprehenderetur ab intellectu, et tunc quaeratur, utrum apprehensione incomplexa, vel complexa? non incomplexa, quia talis non est scientia, cum sit acquiribile ab intellectu de quocumque complexo, vel incomplexo. Modo scientia non acquiritur sine evidentia alicujus principii, vel experientiae, praedeterminante intellectum. Non complexa, quia maxime esset talis conclusio vera: sed illud est falsum, quia multoties scimus, et cognoscimus per conclusiones, cum non consideramus de veritate, vel de falsitate earum.’ (*In I Meteor.*, q. 1, 3). Gregory renders Pseudo-Scotus’s last claim intelligible: ‘Si dicatur quod conclusio apprehenditur apprehensione iudiciaria et enuntiatiua, hoc erit, ut videtur, apprehensio, qua cognoscitur ipsa conclusio esse conformis rei seu esse vera, nam nulla alia videtur esse ad propositum; sed certum est quod non quilibet demonstrans habet talem notitiam de sua conclusione. Unde nec geometra demonstrans latera trianguli descripti secundum doctrinam primae conclusionis Primi Euclidis esse aequalia considerat vel apprehendit quod conclusio, quia enuntiat illa esse aequalia, est vera.’ (*In I Sent.*, prol. q. 1, ed. Trapp–Marcolino, p. 4–5). Cf. the same argument made by Marsilius of Inghen, *In I Sent.* q. 2, a. 3, in *Quaestiones super quattuor libros ‘Sententiarum’*, ed. by M.S. Noya (Leiden: E.J. Brill, 2000), vol. 1, p. 79.

⁶⁸ ‘Alia via est, quod objectum scientiae est significabile complexe, per conclusionem scitam, sicut objectum istius, *Homo est risibilis*, est, *hominem esse risibilem*, quod probatur, quia objectum notitiae habitae per experientiam est tale significabile complexe; igitur est

arrives is the same knowledge that a quarryman has; and yet this quarryman does not have knowledge neither of the geometrical proposition that signifies the centre of the circle, nor of the circle in itself: he knows only the situation of the centre of the circle.

Against the notion of a *significabile complexe*, the arguments mobilise the ontological question of whether it is something distinct from the signified thing or not. An Aristotelian principle is invoked in order to certify that ‘to be the same’ (*esse ipsum*) and ‘the same’ (*ipsum*) are identical (*Metaph.* 1017a 27–30 and 1029b 13–15), therefore the significabile ‘Deum esse’ is identical with ‘Deus’.⁶⁹ If indeed the complex signifiable ‘Deum esse’ were something distinct from God, it would follow that it is a co-eternal thing, not created by God and therefore independent from God. Moreover, this signifiable would not be submitted to God’s will and power: God cannot destroy the signifiable ‘Deum esse’, for He would destroy Himself.⁷⁰

This argument from the co-eternal and independent truths became the main tool used by the Parisians against Gregory. Marsilius of Inghen has a more elaborate version of it, through which we can grasp its force. The question Marsilius asks is: ‘utrum “Deus esse” est aliquid vel pure nihil’. If it is *nothing*, ‘as

cujuslibet alterius notitiae. Consequentia tenet, quia ubique videtur iudicium idem esse. Et antecedens patet, quia si sentiam ignem esse calidum, per istam experientiam non solum cognosco ignem, nec solum caliditatem, sed cognosco ignem esse calidum.’ (*In I Meteor.*, q. 1, 4).

⁶⁹ ‘Contra istam viam arguitur, primo, quia vel tale significabile complexe est res distincta a re significata, vel non. Si sic, contra, primo per Aristotelem 5. Metaphysic. ubi dicit quod in dictis secundum se, idem est esse ipsum, et ipsum, sicut idem est esse Deum, et Deus.’ (*In I Meteor.* q. 1, 4). Cf. Marsilius: ‘Et ergo tenendo suppositionem est prima propositio haec contra hanc opinionem: “Deum esse est Deus”. Probatur primo sic auctoritate Philosophi 7 Metaphysicae dicentis: “In dictis secundum se est idem ipsum et esse ipsum.” Sed manifestum est quod de Deo dicitur esse secundum se; igitur esse Deum est Deus vel Deum esse est Deus’ (*In I Sent.*, q. 2, ed. Noya, pp. 81–2).

⁷⁰ ‘Secundo, quod si esset tale distinctum, sequeretur quod est aliquod ens coaeternum cum Deo, quod Deus, nec posset augmentare, nec diminuire, nec annulare, dato quod Deus esse infiniti vigoris, sicut concedimus ipsum esse.’ (*In I Meteor.* q. 1, 4).

master Gregory says', there can be no science of things, and the object of science would be a pure non-being, which sounds upsetting to the scientist. If the proposition 'Deum esse' is *something* though, distinct from God, it follows that we must concede two original principles (*duo prima*), which sounds upsetting to both philosophers and Catholics. To explain this last consequence: the fact that God is the first incomplex thing needs no comment (in virtue of God's simplicity); in addition, there seems to be an order between the signifiabiles too, for 'man having a rational soul' seems to be prior to 'man being able to be educated', such that one can be said to be the cause and the other, the effect. We are now in a causal chain of *significabiles*: we must look for the first cause or an original *significabile*, since there can be no infinite causal regress. The first *significabile* cannot be God, for God is simple. It cannot be dependent on God (*non sit a Deo*) because God cannot destroy the significance 'God is', for that would mean he would destroy himself (the formulation Marsilius gives to this thesis is a little more intricate: for then God could destroy the significance 'Deum esse' and still be; it's the same argument made by Pseudo-Scotus that, if the signifiabiles are independent of God, than God cannot destroy 'Deum esse'). The *significabile* must therefore be an original complex independent thing. In this way we arrive at the upsetting conclusion of having two original principles: 'Deum esse' is a truth independent from God and as equally necessary as God.⁷¹

The eternal truths argument is revived against Gregory's *complexe significabile* by Buridan, Pseudo-Scotus, Marsilius, Pierre d'Ailly, Paul of Venice up until the sixteenth century.⁷² The idea that co-eternal truth exists alongside God is circulated in Paris on lists of articles condemned under the title 'quod multae fuerunt veritates ab aeterno quod non erant Deus'. This condemned article was signalled by Hubert Élie as part of a presupposed theological condemnation of 1340, not to be found.⁷³ Alain de Libera has retraced the article back to the Parisian condemnation of January 1241 (!) initiated by William of Auvergne

⁷¹ Marsilius, *In I Sent.*, q. 2, ed. Noya, pp. 83–4.

⁷² See A. de Libera, *La référence vide* and E.J. Ashworth, 'Theories of the proposition'.

⁷³ H. Élie, *Le complexe significabile*, p. 72.

against ‘the other’ nominalists, the twelfth-century logicians.⁷⁴ It is a rare and interesting connection between the two currents. I can add that this thesis has preoccupied logicians at least since Philippe the Chancellor’s *Summa de bono*, who argues against it in his treatment of the transcendental truth.⁷⁵

It is quite an unfair case to make against Gregory. Marsilius’s question, ‘utrum “Deus esse” est aliquid vel pure nihil’, intentionally ignores Gregory’s discussion of the three senses of being for which he is best remembered. *Aliquid*, *res* or *ens*, as synonymous terms, are said in three ways according to Gregory. ‘In a first sense, very generally (*communissime*), any signifiable, complex or incomplex, true or false, is said a thing or something.’ ‘In a second sense, these terms are used for any signifiable, complex or even incomplex, but true, that is, for a true proposition.’ ‘In a third sense, these terms are understood as signifying an essence or an existing entity’.⁷⁶ The first sense of ‘something’ is a general sense indifferent to truth or falsity; the second sense is indifferent only to existence, not

⁷⁴ A. de Libera, *La référence vide*, pp. 177–87 (‘D’une condamnation fantôme: la pseudo-censure parisienne de 1340’). *Chartularium Universitatis Parisiensis*, ed. by H. Denifle and É. Chatelain (Paris: Delalain, 1889–1897), vol. 1, coll. 170.

⁷⁵ See H. Pouillon, ‘Le premier traité des propriétés transcendantes. La «Summa de bono» du Chancelier Philippe’, *Revue néo-scholastique de philosophie* 61 (1939): pp. 40–77. For William of Auvergne, see N. Lewis, ‘William of Auvergne’s Account of the Enuntiable: its Relations to Nominalism and the Doctrine of the Eternal Truths’, *Vivarium* 33 (1995): pp. 113–36.

⁷⁶ ‘Dicendum quod hoc nomen “aliquid” sicut et ista alia sibi synonyma “res” et “ens” possunt accipi tripliciter: uno modo communissime secundum quod omne significabile incomplexum vel complexum, et hoc vere vel false dicitur res et aliquid. . . . Alio modo sumuntur pro omni significabili complexum vel etiam incomplexum, sed vere, id est per veram enuntiationem; quod autem false, tantum dicitur non ens. . . . Tertio modo sumuntur ista ut significant aliquam essentiam seu entitatem existentem . . . Nunc ad argumentum, cum quaeritur, utrum illud totale significatum sit aliquid vel nihil, dico quod, si “aliquid” sumatur primo vel secundo modo, est aliquid; si vero tertio modo sumatur, non est aliquid. Unde hominem esse animal non est aliquid, sed est hominem esse substantiam animatam, sensibilem, rationalem; nec hominem esse risibilem est aliquid, sed est hominem posse ridere.’ (Gregory, *In I Sent.*, prol., q. 1, ed. Trapp–Marcolino, pp. 8–9).

to truth or falsity; and the third sense is indifferent to neither: it must be both true and existent. The purpose of Gregory's distinction is to separate the third sense of 'something', that of an existent being in the world, from the other two senses of 'something', that are said without regard to whether they exist or not. The total significate of the proposition can be said to be *something* (*aliquid*, *res* or *ens*) only in the first and second sense, but not in the third sense: it is not an existent being in the world. In Gregory's terms, it is a non-existent being, but is not *nothing*.⁷⁷ Gregory had laid down this theory of the three senses of being precisely as a preemptive defence against this kind of 'ontologisation' of the *significabile complexe*. Granted, this can give way to paradoxical readings, and Marsilius famously complains about the non-intelligibility of something that is not a substance, nor an accident, nor nothing.⁷⁸ Nevertheless, Gregory's intention to exclude a reading of the signifiabiles as existing entities in the outside world is clear. Gregory's critics, by making the argument that the signifiabiles co-exist alongside God, understand them in the third sense: they co-exist in the same sense in which God exists, something that Gregory denies explicitly.⁷⁹

⁷⁷ 'Sed ulteriorem consequentia nego, qua dicitur 'igitur scientia nullum habet obiectum', nam habet obiectum, quod non est ens.' (Ibid., p. 9).

⁷⁸ 'Hic modus de significabilibus complexis distinctus a rebus incomplexis vel est adeo subtilis quod imaginationem communium excedit et praesertim meam, vel fortassis est ex ignorantia logicae introductus.' (Marsilius, *In I Sent.*, q. 2, ed. Noya, p. 81). To grasp the distinction that Gregory makes between the third sense of being and the first two, Alain de Libera has proposed to think of it in terms of a distinction between 'being eternally', which the signifiabiles are not, in spite of the critique mounted against them, and 'being true eternally', which the signifiabiles are, as contingent truths dependent upon God's understanding. *La référence vide*, pp. 219–21. See also Gregory in *In I Sent.*, d. 38, q. 2, ed. Trapp-Marcolino, vol. 3, p. 304.

⁷⁹ Pascale Bermon argues, against Élie and Nuchelman's reading, that, because the signifiabiles are not an existing entity, Gregory is not a 'conceptual realist', a forerunner of the twentieth-century ontology of the object (*L'assentiment et son objet*, pp. 181–4); she rightfully points out that in denying an 'existing entity' to the *signifiable complexe*, Gregory acts as a perfect nominalist. Alain de Libera reexamines the connections between Gregory and twentieth-century philosophy in *La référence vide*. André de Muralt sees in Gregory's theory a

1.2.5 The third way: direct realism

Following Pseudo-Scotus's exposition, we are left with a third solution to the problem of the object of science: the *res extra* itself. The idea that external things are the objects of scientific knowledge is supported through the analogy with sensation: just as the object of vision is not the species, which moves the sense of sight immediately, but the external thing which causes the species, so the object of *scientia* is not the conclusion, which is directly known, but the external thing that it signifies.⁸⁰ Pseudo-Scotus applies this example to meteorology: when we know that the rainbow is caused by the refraction of the rays of light, this cognition does not end in the conclusion that 'the rainbow is caused by the refraction of the rays of light', and it does not terminate in the signifiable of the conclusion, but it ends in the rainbow itself, out of which the cognition of the conclusion that 'the rainbow is caused by the refraction of the rays of light' is ultimately derived. No further development is given to this traditional view.

1.2.6 The threefold object solution

The thesis adhered to by Pseudo-Scotus holds that science has a threefold object: the known conclusion is the immediate object; the 'notitia incomplexa

development of the Scotist notion of objective being (*L'enjeu de la philosophie médiévale*. Leiden: E.J. Brill, 1993, p. 128).

⁸⁰ 'Pro tertia via sit conclusio ista: Res significatae per terminos conclusionis scitae, sunt objecta scientiae. . . . Istud apparet in exemplo, nam objectum sensationis, sicut visionis, non dicitur species, quae immediatae movet visum; sed objectum dicitur res ad extra, sicut paries, vel aliquod hujusmodi, a quo causatur ista species.' (Pseudo-Scotus, *In I Meteor.*, q. 1, p. 5b).

terminorum', the terms of the proposition, constitute the 'more mediated' object; the things outside of the mind are the ultimate object of science, in which the notions of the terms terminate and out of which the conclusions are ultimately derived. Pseudo-Scotus claims to present a synthesis of the three positions (*concordando istas opiniones*). This is misleading. It is *not* a synthesis of the three ways, because what he presents as the agreement omits the *significabile complexe*, replacing it with the terms of the proposition. He uses the term 'significabile per conclusionem', that may suggest the *significabile complexe*, but he then explains it as 'the incomplex notion of the terms':

Sciendum tamen, concordando istas opiniones, quod quidlibet istorum potest dici obiectum scientiae, scilicet tam conclusio scita, quam significabile per conclusionem, quam etiam res significata per ipsum. Unde conclusio potest dici obiectum, eo quod ipsa immediate obiicitur intellectui: sed de notitia incomplexa terminorum est scientia, tanquam de subiecto magis mediato, sed ultimate. Res extra est obiectum, a quo aliae notitiae tam terminorum, quam conclusionis derivantur.⁸¹

The thesis laid down secures access to the external thing, mediated by the terms of the proposition, and further mediated by the proposition itself. Marsilius offers, once again, a development of the argument—as a refutation of Gregory, correctly, and not as a 'synthesis' of the three views. Marsilius speaks of the proximate object (the proposition), the remote object (the terms as signs) and the most remote or ultimate object, the things in themselves:

Tertio suppono quod obiectum assensus immediatum est propositio; remotum, eius termini inquantum signa sunt

⁸¹ *In I Meteor.*, q. 1, p. 6a.

rerum; et remotissimum et ultimum et etiam maxime intentum est res incomplexa significata per terminos, saltem in affirmativis de inesse et de praesenti.⁸²

For instance, explains Marsilius, the immediate object of the knowledge and assent to the proposition ‘God is’ is the proposition itself; the middle-way object (*remotum*) is the term ‘God’ as a sign for the First Being; the last object (*remotissimum*) is the First Being itself.

The thesis arises in Marsilius as a refutation of Gregory. While, in the way it is presented, it would seem like a doctrinal evolution, Marsilius presents it as the reverse of the Ockhamist position: we know directly the conclusion, and only through it, its significate. He states: ‘this appears to be the opinion of many people and especially that of Ockham in the fourth question of his Prologue and it is the common opinion.’⁸³ It is unclear to which passage Marsilius wants to refer his readers. Rather than the fourth question of Ockham’s prologue, which deals with the derivation of properties from the prime subject, the ninth question, on ‘Utrum Deus sub propria ratione deitatis sit subiectum theologiae’, seems a more appropriate reference. Ockham here distinguishes between the subject as ‘that which supposits’ (*pro illo quod supponit*) and the subject as that which is supposed (*pro illo pro quo supponitur*). God is the subject of theology, if by subject we understand the *significate* (*illo pro quo supponitur*), in an improper manner; but God is not the subject of theology, if by subject we understand the *signifier* (*pro illo quod supponit*), as we normally do. The term ‘God’ acts as a sign, a concept that is directly connected to the thing outside of the mind, the First

⁸² Marsilius, *In I Sent.*, q. 2, a. 3, ed. Noya, p. 78. See also *Quaestiones super libros Priorum analyticorum* (Venice, 1516), lib. I, q. 1. The first text speaks of the object of assent, while the second text speaks of the object of knowledge: they are the same for Marsilius.

⁸³ ‘Haec videtur esse mens multorum et praesertim Ockham in quarta quaestione prologi et est communis opinio.’ (Marsilius, *In I Sent.*, q. 2, a. 3, ed. Noya, p. 79).

Being.⁸⁴ In this way, Ockham can avoid accusations of scepticism with reference to the idea that the conclusion is the object of science, of the kind that are raised in this debate, through his theory of personal supposition, which guarantees the connection between the term and the *res extra*.⁸⁵ Marsilius, writing a generation after Gregory, can fully appreciate this, and can present the thesis of the threefold object of science as derived from Ockham's theory of supposition.

A question of priority remains to be settled. The thesis of the threefold object of science has been associated with Marsilius of Inghen, and it is apparently through Marsilius that it has been transmitted to the *nominales* of the fifteenth century.⁸⁶ Marsilius lectured on the *Sentences* in Heidelberg in 1392–1394, but he started his theological studies sometime around 1366 in Paris and could have

⁸⁴ 'Et dico, primo, quod accipiendo subiectum pro illo quod supponit, quod Deus sub ratione deitatis non est subiectum theologiae nostrae. Hoc patet, quia subiectum isto modo dictum est terminus conclusionis. Sed Deus non est terminus conclusionis, quia illud est terminus conclusionis quod immediate terminat actum intelligendi vel est actus intelligendi. Sed Deus in se non immediate terminat actum intelligendi sed mediante aliquo conceptu sibi proprio, nec est conceptus. . . . Secundo, dico quod accipiendo subiectum pro illo pro quo supponitur, sic respectu alicuius partis Deus sub ratione deitatis est subiectum . . . Hoc patet, quia in aliquibus veritatibus terminus primo supponit pro ipso deo in se, sicut in ista: Deus creat, Deus est Pater et Filius et Spiritus Sanctus, et sic de aliis. In aliquibus terminus primo supponit pro Patre, sicut in istis: Pater generat, Pater constituitur ex paternitate. Et sic de Filio et Spiritu Sancto et creatura. Sed illud pro quo supponitur est subiectum isto modo dictum, improprie loquendo.' (Ockham, *In I Sent.*, prol., q. 9, in *Opera theologica*, vol. 1, pp. 268–9).

⁸⁵ See P. Boehner, 'Ockham's Theory of Supposition and the Notion of Truth', *Franciscan Studies* 6 (1946): pp. 261–92.

⁸⁶ For instance, A. de Libera, *La référence vide*, p. 190 speaks of 'la théorie de Marsile de Inghen, devenue au XVI^e siècle la « thèse commune »' (assertion based on Ashworth). H. Élie, *Le complexe signifiable*, pp. 56–7, maintains that Marsile takes the thesis directly from Ockham, without offering any proof. If the indexes of the Franciscan Institute edition are to be trusted, a tripartite distinction of the *scibile* in Ockham, of the kind Marsilius puts forward, is not to be found. See also S. Lalla, *Secundum viam modernam: ontologischer Nominalismus bei Bartholomäus Arnoldi von Usingen* (Würzburg: Königshausen & Neumann, 2003), pp. 315–18, for Usingen's attribution of this view to Marsilius.

gathered material around that time. His dates are thus close to the presumed dates of Pseudo-Scotus (1350's). But it is unlikely that the latter knew of Marsilius's commentary, for he does not report any of the otherwise interesting argument he contributes to the discussion. More importantly, I can report that the thesis of the threefold object of science is in circulation at least since Buridan, who reported it in several places, including his *Meteorology*: (1) Buridan presents the threefold sense of the *scibile*—which is the basis for the threefold object of science thesis—in his *An. Post.* I, q. 2: the proposition is the *scibile primum et immediatum*, the terms of the proposition are a second sense of the *scibile*, and the signified things are a third sense.⁸⁷ (2) Buridan applies the threefold object thesis in the first question of his commentary on the *Physics* I, saying that the demonstration does not consist in just the conclusion, but also in the terms that compose the conclusion together with their significate.⁸⁸ (3) His questions on *Meteorologica* then use the view in the same way as Pseudo-Scotus does.⁸⁹

⁸⁷ 'Et tunc sciendum est quod triplex est 'scibile', scilicet per demonstrationem. Primum et immediatum scibile est conclusio demonstrabilis, quae ex eo dicitur sciri quia ex praemissis notis concluditur. Secundo modo, 'scibilia' dicuntur ex quibus conclusio demonstrabilis componitur. Unde, sicut dicimus nos scire talem conclusionem et eam nobis esse demonstratam, ita saepe dicimus tale praedicatum esse scitum et demonstratum de tali subiecto. Deinde, tertio modo, scibilia sunt res significatae per terminos conclusionum demonstrabilium, et ita dicimus nos habere scientiam de animalibus et lapidibus, de deo et intelligentiis, et sic de aliis.' (Buridan, *In I An. Post.*, q. 1, 6 in *Iohannis Buridani Quaestiones in duos libros Aristotelis Posteriorum Analyticorum*, unpublished transcript by H. Hubien, URL: http://individual.utoronto.ca/pking/resources/buridan/QQ_in_Post_An.txt, accessed in January 2014).

⁸⁸ 'Ad demonstra-tionem autem plura concurrunt, scilicet premissae et conclusio et termini ex quibus constituuntur premissae et conclusiones, et res significatae per illos terminos, et de omnibus illis dicitur haberi scientia.' (Buridan, *In I Phys.*, q. 1, in *Quaestiones super octo libros Physicorum Aristotelis*, ed. by J. Dullaert [Paris, 1509, reprint Frankfurt am Main: Minerva, 1964], f. 2va).

⁸⁹ 'De secunda dubitatione, dicendum est Primo posteriorum quod tripliciter potest esse de aliquibus scientia: uno modo, tamquam de conclusionibus demonstratis quae sunt scibilia, propria et propinqua; alio modo, tamquam de terminis ex quibus ille conclusiones

Conclusion

We can now locate Pseudo-Scotus' questions on *Meteorologica* with a little more precision in the Parisian intellectual setting of the second half of the fourteenth century. The Parisian discussion of the object of science suggests the following chronological sequence. As far as I can tell, Buridan is probably the initiator of the theory of the threefold object of science maintained by all Parisian masters associated with him, whom we have discussed in this essay.⁹⁰ The fact that when Marsilius reports the threefold object view he assigns it directly to Ockham suggests that the perception of what Ockham's view actually was evolved since Gregory's critique of the conclusion thesis. Initially, Ockham is read by someone like Gregory (indirectly, as we have seen, through Adam's report on Chatton's critique) as proposing that the object of science is the conclusion of a syllogism, with the sceptical danger of preventing the access to the world outside of the mind. While arguing against Gregory's theory of the *significabile complexe*, Buridan and his intellectual circle, including Themon and Pseudo-Scotus, developed the theory of the threefold object of science. This theory is then read back into Ockham's theory of supposition, and rightfully so, at least by someone like Marsilius. Marsilius's threefold object view presents a 'truer' Ockham than that of Gregory. It is worth noting that a consequence of the general rejection of

componuntur; et tertio, tamquam de rebus per terminos conclusionum significatis.' (Buridan, *In I Meteor.*, q. 1, ed. Bages, p. 5).

⁹⁰ T.K. Scott, 'John Buridan on the objects of demonstrative science', *Speculum* 40 (1965): pp. 654–73, shows that Buridan used the older theory of natural supposition to oppose Ockham's view that demonstrative propositions are to be considered as hypothetical ('Man is able to laugh' should be read as 'if a man exists, it is able to laugh'). This is a side issue; Buridan seems to me to stay close to Ockham's understanding of personal supposition with his use of the threefold *scibile* as a mean to reach the objectivity of knowledge.

Gregory's theory of the *significabile complexe* is a deeper appreciation of Ockham. By the sixteenth century, the discussion of the total significate of the proposition became a standard topic in commentaries on the *Posterior Analytics*, and the nominalist threefold object solution became the most common opinion.⁹¹

The solution developed by the Parisian masters justifies the study of language as part of the study of nature. Marsilius asks: what would be the purpose of studying the terms, other than to grant epistemic access to their reference?⁹² From the point of view of securing the Aristotelian demonstrative science, the threefold object thesis has the obvious advantage of granting access to both contingent things (the ultimate object) and to necessary propositions (the immediate object): we can say necessary truths about changing things. In forging this view, Parisian philosophers adapted to what was asked of them. In addition to condemning the *significabile complexe*, the Statute of the Parisian Faculty of Arts of 29 December 1340 asked from its scholars a 'realist' opinion about science as being, ultimately, about *things*, not about *signs*:

Quod nullus dicat scientiam nullam esse de rebus que non sunt signa id est que non sunt termini vel orationes quoniam in scientiis utimur terminis pro rebus quas portare non possumus ad disputationes. Ideo scientiam habemus de rebus licet mediantibus terminis vel orationibus.⁹³

⁹¹ See E.J. Ashworth, 'Theories of the proposition', which investigates Thomas Bricot, Juan Celaya and Antonio Coronel.

⁹² 'Quae enim esset cura homini de cognitione orationis vel terminorum, nisi eis mediantibus haberet cognitionem rerum incomplexarum per terminor significatorum?' (Marsilius, *In I Sent.*, q. 2, a. 3, ed. Noya, p. 79).

⁹³ *Chartularium Universitatis Parisiensis*, vol. 2, n. 1042. This article should be coupled with the articles condemning the *significabile complexe*: section VI of the Statute of 29 December 1340 ('quod nullus asserat . . . quod Deus et creatura nihil sunt') and Autrecourt's 'semantic' articles condemned in 1346 (31 and 57: 'quod Deus et creatura non sunt aliquid'; 58: 'quod significabile complexe per istud complexum 'Deus et creatura distinguuntur' nihil est'). For

The Statute of December 1340 is, in this way, institutionalizing the thesis of the threefold object of science discussed in this chapter.

more details on the condemnation of the *complexum significabile* in Paris, see H. Élie, *Le complexe significabile*, pp. 37–40 (who saw Autrecourt as a scapegoat for Gregory), R. Paqué, *Das Pariser Nominalistenstatut: Zur Entstehung des Realitätsbegriffs der neuzeitlichen Naturwissenschaft* (Berlin: Walter de Gruyter, 1970), especially pp. 198–232, K. Tachau, *Vision and certitude*, pp. 353–7 and J.M.M.H. Thijssen, ‘The “semantic” Articles of Autrecourt’s Condemnation. New Proposals for an Interpretation of the Articles 1, 30, 31, 35, 57 and 58’, *Archives d’histoire doctrinale et littéraire du Moyen Âge* 57 (1990): pp. 155–75.

2 *Utrum elementa maneant in mixto.* Duns Scotus and the medieval ontology of mixture

After having looked at the epistemological basis for determining the scientific character of meteorology, we turn in this chapter to an examination of its ontological foundations. Meteorology treats mixed bodies of a certain kind: imperfect mixtures, characterized by the fact that they retain the substantial form of the element out of which they originate. I will develop the definition of the meteors in the following chapters; for now, I look the ontology of mixtures in general.¹

Medieval philosophers expended a great amount of effort on Aristotle's theory of mixture and developed various accounts of how mixtures arise out of the four Empedoclean elements.² While presenting the most important medieval solutions proposed, the chapter focuses on Duns Scotus, who provides a highly original treatment of mixtures. John Duns Scotus held a radical set of theses on

¹ This chapter is based on 'John Duns Scotus and the ontology of mixture', *Res philosophica* 91 (2014): pp. 1–23.

² The term 'mixture' is highly ambiguous in English. It refers both to the process, *mixtio*, and to the result, *mixtum*. Moreover, the term is used in common speech with a sense that corresponds rather to Aristotle's *synthesis*, a juxtaposition of elements, or to its result. I will not use this later sense. I prefer to let the context clarify the ambiguity between *mixtum* and *mixtio*, rather than use the ad-hoc term 'mixt', which some of the literature uses (on the model of the French *le mixte*).

the theory of mixture: that the elements are not kept in the mixtures neither with respect to their form, nor with respect to their qualities;³ that a single element can give rise to a mixt;⁴ that mixtures are not generated through the mutual action of the elements; and that they cannot be generated out of the *four* elements *at all*.⁵ Consequently, he rejected Aristotle's theory of *mixtio* as a process distinct from generation, corruption or alteration. This chapter will argue that Scotus's view on mixtures went contrary to an entire tradition that endured until Padouan Averroism and sixteenth-century Thomism.

Current knowledge of the development of this discussion in Latin philosophy rests on Anneliese Maier's classic study 'Die Struktur der Materiellen Substanz' (1943).⁶ Maier studied most of the works from the fourteenth century that were available to her at that time and followed the medieval problem of 'whether the elements remain in the mixt'. I will come back to Maier's thesis in chapter 3, where I look at the coherence of the Aristotelian teaching course and the place of *Meteorologica* in it. I seek here a reassessment of Duns Scotus's position in the historical development of this discussion and argue that his account was more original than previously thought. Maier noted the importance

³ 'Ideo est alia opinio, quam teneo, quod formes elementares non manent in mixto secundum suas essentias, nec eorum qualitates'. (*Lect.* II, d. 15, q. un., 26., in *Opera omnia* [Vatican City: Typis Polyglottis Vaticanis, 1950–], vol. 19, pp. 137–15.)

⁴ 'Similiter ex uno elemento generatur mixtum'. (*Lect.* II, d. 15, q. un., 29.)

⁵ 'Ideo dico quod nunquam est necesse quod genereretur mixtum ex quatuor elementis concurrentibus, etiamsi concurrant per virtutem divinam, vel qualitercumque, nunquam ex eis generatur mixtum'. (*Rep.* 2A, d. 15, q. un., 6., in *Opera omnia*, ed. by L. Wadding [Lyon: Durand, 1639], vol. 11, pp. 343–5.) 'Credo autem quod numquam mixtum generatur ex quattuor elementis mutuo agentibus'. (*Lect.* II, d. 15, q. un., 30.)

⁶ A. Maier, *An der Grenze von Scholastik und Naturwissenschaft* (Rome: Edizioni di Storia e letteratura, 1952), pp. 1–140. See also a summary of the discussion, largely based on Maier, in R. Wood, 'The Influence of Arab Aristotelianism on Scholastic Natural Philosophy', *The Cambridge History of Medieval Philosophy*, ed. by R. Pasnau and C. Van Dyke (Cambridge: Cambridge University Press, 2011), vol. 1, pp. 259–65 and J.M.M.H. Thijssen, 'Some reflections on continuity and transformation of Aristotelianism in medieval (and Renaissance) natural philosophy', who discusses briefly mixture in Marsilius of Inghen.

of Duns Scotus's account for the subsequent views of authors such as William of Ockham or Gregory of Rimini, but she still treated him as developing a Thomist view on mixtures. She speaks of a 'clarification' of the Thomist theory (*An der grenze*, p. 107) and of a 'Thomist-Scotist view' (p. 111). To appreciate Scotus's novelty, a revision of the main solutions provided within Latin Aristotelianism is needed. I will thus revisit four main authors: Avicenna, Averroes, Thomas Aquinas, and Duns Scotus.

In the first section, I set the stage by summarizing the problem posed by Aristotle's conception of mixtures. In the second section, I present the key positions inherited by the Latins from Arab philosophy. In the next two sections, I present Thomas's and Scotus's views. I end the chapter with a number of conclusions on Scotus's position.

2.1 The Aristotelian ontology of mixture

The development of the ontology of mixture in Latin philosophy took place in commentaries to Aristotle's *De Gen. et corr.*, in theological lectures on Book II of Peter Lombard's *Sentences*, in discussions over the creation of matter and organisms, in some elucidations of the composition of material substance from *De Coelo*, *Physica* and *Meteorologica IV*, and in the medical literature on Avicenna's *Canon* and Galen's doctrine of the humours. While these places sometimes bring about important elaborations and are of great significance for the historical transmission of ideas, the core of the late medieval doctrine of mixtures was formulated with respect to chapter 10 of book I of Aristotle's *De Gen.* and with respect to Averroes's position.

Mixtures are sublunary bodies composed of the four primary elements (fire, water, earth, air). They compose the entire material world and they are the subjects of natural science. The problem of their ontological representation arises from the fact that the doctrine of hylomorphic composition, the basic Aristotelian account of how things change, intervenes at every level of the physical

architecture: cats have matter and form, flesh and bones have matter and form, and the four elements themselves have matter and form. The need to describe mixed bodies in terms of metaphysical parts, as composites of form and matter, gave rise to the famous medieval debate: the question of *whether* the four elements are kept in the mixture, and if so, *how*. *De Gen.* I, 10, 327b 1–6 presents the original puzzle: either the elements *are* kept in the mixture, and in this case we do not have a proper case of mixture, but a mere juxtaposition of elements, a mechanical mixture (*synthesis*); or they *are not* kept in the mixture, and in this case we have a simple case of corruption and generation of a new substance. Aristotle's own solution was to posit mixture as a type of substantial transformation different from generation, corruption, and alteration. In the operation of mixture, elements are not *quite* preserved but also not *quite* destroyed (*quodammodo manent et quodammodo non*, repeated the Latins). Aristotle explains this ambiguous persistence by appealing to his distinction between actual and potential being. According to the most widespread Latin reading of this text, elements are kept potentially or virtually, not *in actu*, in the mixture (327b 22–31). To use Aristotle's term, they keep their *dynamis* (327b 30, *virtus* or *potentia*). This was meant to explain both the permanence of the elements and their regeneration when the mixed body is dissolved.⁷

⁷ This reductive summary cannot give justice to the complexity of Aristotle's account or to the extensive literature devoted to it. But I am only concerned here with a basic account that medieval philosophers would have been familiar with. Recent discussions are provided by D. Frede, 'On Generation and Corruption I. 10: On Mixture and Mixables', in *Aristotle: On generation and corruption, Book I. Symposium Aristotelicum*, ed. by F. de Haas and J. Mansfeld (Oxford: Clarendon Press, 2004), pp. 289–314 and by J.M. Cooper, 'Two notes on Aristotle on mixtures', in his *Knowledge, Nature and the Good. Essays on Ancient Philosophy* (Princeton: Princeton University Press, 2004), pp. 148–73. I rely also on H.H. Joachim's commentary, *Aristotelous Peri geneleos kai fthoras* (Hildesheim: G. Olms, 1970, reprint of 1922); his 'Aristotle's Conception of Chemical Combination', *Journal of Philosophy* 29 (1903), pp. 77–86; R. Sorabji *Matter, Space and Motion: Theories in Antiquity and Their Sequel* (London: Duckworth, 1988), pp. 60–78; and M. Rashed's exhaustive commentary from his Budé edition of Aristotle, *De la generation et la corruption* (Paris: Les Belles Lettres, 2005).

The Greek commentators on Aristotle developed important accounts of mixture, as did the Stoic tradition and Neoplatonic authors. The most consequential of the ancient commentator's accounts was that of Philoponus, through its influence on Arab philosophy. However, Latin philosophers largely ignored the ancient accounts until their rediscovery in the sixteenth century or read them occasionally through the Arab filter, and hence they fall out of my scope here. When the views of the Greek commentators are reconsidered in the Renaissance, the opinions of Latin philosophers on mixture are already formed. Zabarella, for instance, will not shy away from claiming that both Alexander of Aphrodisias and Philoponus actually support Averroes.⁸ Regarding the Stoics, aside from problems of transmission, their 'body going through body' theory—the idea that different substances are able to exist in the same place at the same time—would have been too far from Aristotle to raise any significant interest.⁹

The only sources used actively by Latin philosophers when discussing mixture were thus Aristotle, Averroes, and Averroes's reading of Avicenna. We can use the exegesis of the sixteenth-century philosopher Giacomo Zabarella as a historical guide into the positions known and developed by Latin Aristotelianism.

⁸ Giacomo Zabarella, *De rebus naturalibus libri XXX*, (Paris: R. Meietti, 1604 [first edition Cologne, 1590]), pp. 240a–241a ('Confirmatio eiusdem sententiae auctoritate graecorum interpretum').

⁹ Only few Greek commentaries on *De Gen.* have survived: Philoponus's, and through it, fragments of Alexander's, and Alexander's *De mixtione*, mostly concerned with refuting the Stoic position. See R.B. Tod, *Alexander of Aphrodisias on Stoic Physics: A Study of the De Mixtione* (Leiden: E.J. Brill, 1976); D.E. Hahm, 'The Stoic theory of change', *Southern Journal of Philosophy* 13 (1985): pp. 39–56; E. Lewis, 'Diogenes Laertius and the Stoic theory of mixture', *Bulletin of the Institute of Classical Studies* 35 (1988): pp. 84–90; F.A.J. de Haas, 'Mixture in Philoponus. An Encounter with a Third Kind of Potentiality', in J.M.M.H. Thijssen and H.A.G. Braakhuis, *The Commentary Tradition on De generatione et corruptione: Ancient, Medieval and Early Modern* (Turnhout: Brepols, 1999), pp. 21–46. In general, see R. Sorabji, *The Philosophy of the Commentators. 200–600 AD. A Sourcebook* (Ithaca, NY: Cornell University Press, 2005), vol. 2, pp. 290–315, for a fast and useful presentation of the ancient commentators' views on mixture, with texts and references to bibliography.

Zabarella wrote a *Liber de mistione* towards the end of the philosophical lifespan of the Aristotelian theory of mixtures. He divided the positions available to him between the four authors mentioned: Avicenna, Averroes, Saint Thomas together with ‘the rest of the Latins’, and Duns Scotus. These authors provided for him a complete panorama of possible solutions.¹⁰

The technical question posed by the commentators, according to Zabarella, was: Are the elements kept in the mixture at the level of their (substantial) *form*, or are they kept at the level of their *qualities*?¹¹ Zabarella recited Avicenna’s position (1), who held that the elements are kept in the mixture at the level of forms, while their qualities, though also kept, are ‘remitted’ (*remittae, castigatae, diminutae*, and *fractae* were some of the terms used).¹² ‘Remission’ is a technical term that expresses a reduction of the intensity of a quality, coined in order to allow the interaction of elemental qualities: in their highest degree, the elemental qualities are contrary to each other in couples of two (wet is contrary to dry, hot is contrary to cold), and therefore cannot interact or combine—hence their remission. Averroes (2), the second opinion recited by Zabarella, proposed the remission of both elemental forms and qualities.¹³ Thomas Aquinas (3) held that

¹⁰ *Liber de mistione*, in *De rebus naturalibus libri XXX* (ed. 1604), pp. 231–45 (‘Avicennae opinio’, ‘Averrois opinio, et adversus Avicennam disputatio’, ‘Scoti opinio’, ‘Aliorum latinorum opinio’).

¹¹ ‘Hac igitur de re est nobis in praesentia disputandum, ut omni, si fieri possit, difficultate sublata, definitio mistionis clara & perspicua reddatur; quam bene intelligere non possumus, nisi ea, quae tetigimus, dubia solvantur: haec autem duo sunt potissime, unum de formis elementorum, an servantur in misto, alterum de eorundem qualitatibus, quas in praesentia statuimus, non esse formas elementorum, sed accidentia consequentia. Repugnantia autem praedicta traxit alios in varias opiniones, quae mihi videntur quattuor esse ad summum.’ (*De rebus naturalibus*, p. 231a–b).

¹² ‘ . . . putavit enim Avicenna formas elementorum remanere in misto integras, & nulla ex parte laesas; qualitates vero manere quidem, non tamen integras, sed castigatas, & fractas ob mutuam inter se actionem & passionem.’ (Ibid., p. 231b).

¹³ ‘Secunda est Averrois opinio . . . ubi dicit, tam formas substantiales elementorum quam qualitates manere actu in misto, fractas tamen omnes, & castigatas, & ad mediocritatem redactas.’ (Ibid., p. 232a).

the elemental forms were entirely destroyed in the mixture and that only their remitted qualities were kept.¹⁴ Finally, (4) Duns Scotus held that both the substantial form and the elemental qualities were destroyed in the mixture.¹⁵ For the sake of comprehensiveness, these four positions can be represented as follows:¹⁶

<i>Opinions</i>	<i>Elemental substantial forms in the mixt</i>	<i>Elemental qualities in the mixt</i>
Avicenna	+	+, but remitted
Averroes	+, but remitted	+, but remitted
Thomas Aquinas	—	+, but remitted
John Duns Scotus	—	—

In what follows, I defend the historical sketch proposed by Zabarella by presenting the accounts of these four authorities.

¹⁴ ‘Quarta sententia est, ut mihi videtur, caeterorum latinorum, qui de formis elementorum Scoto consentientes dicunt, eas nullo modo servari, neque integras, neque refractas; sed in qualitatibus ab eo discrepant, has enim putant in misto remanere fractas, & ad mediocritatem redactas’. Zabarella quotes Marsilius of Inghen, Thomas, Aegidius Romanus, Ludovico Boccadiferro and other *recentiores*. (Ibid., p. 233b).

¹⁵ ‘. . . putavit Scotus & formas & qualitates elementorum in mistione penitus interire, & novam misti formam generari, & novam qualitatem, quae est temperatura misti.’ (Ibid., p. 233a).

¹⁶ Zabarella quotes Scotus as the third opinion and Thomas et al. as the fourth opinion. I reverse the positions, for concerns of chronology and conceptual coherence.

2.2 The Arab heritage

The classical place of reference for the medieval discussion is a digression from Averroes's comment 67 on Book III of *De Coelo*, in which Averroes presents Avicenna's opinion alongside his own view.¹⁷ Although Avicenna's view was available from other places (*Sufficientia*, I, 10, i.e., *Physics* I, 10 from the *Shifâ*, and *De Gen.*, 6), medieval philosophers quoted Avicenna's view from Averroes.¹⁸

¹⁷ There is another text on mixture in an insertion at the end of Averroes's *Middle Commentary* to *De Generatione et corruptione*, but this passage is considered an interpolation; however, it is present in the Latin manuscript tradition. For details, see Eichner's commentary *Averroes's Mittlerer Kommentar zu Aristoteles' De generatione et corruptione*, ed. by H. Eichner (Paderborn: F. Schöningh, 2005), especially pp. 134–87. References to vol. 5 of the Junta edition (*Aristotelis Stagiritae de coelo, de generatione et corruptione, meteorologicum, de plantis libri, cum Averrois Cordubensis variis in eosdem commentariis*, Venice, 1562, 'editio Juntina secunda') are: *In III De Coelo*, comm. 67, pp. 226b–7c, and *Media expositio in I De Gen.*, comm. 82–90, pp. 368d–70d.

¹⁸ Avicenna, *The Physics of The Healing*, vol. 1, ed. by J. McGinnis (Provo: Brigham Young University Press, 2009), pp. 67–70. P. 68 (*Physics* I, 10, 7), 'So the essential forms of these [ingredients] remain conserved, while the accidents by which they interact so as to bring about an alteration change and undergo alteration such that as any excess that is in any of its individual [ingredients] decreases until the quality of the overpowering [ingredient] stabilizes in it, falling below the point where it overpowers.' Avicenna provides a much more extended discussion in *De Gen.: Avicenna latinus. Liber tertius naturalium de generatione et corruptione*, ed. by S. Van Riet, introduction by G. Verbeke (Louvain-La-Neuve: Peeters and Leiden: E.J. Brill, 1987), pp. 56–78. For details on Avicenna's account, see Van Riet's commentary and A. D. Stone, 'Avicenna's Theory of Primary Mixture', *Arabic Sciences and Philosophy* 18 (2008), pp. 99–119. The text from *Physics* I was known as part of the *Sufficientia* translated at Toledo in the twelfth century; the second text from *De Generatione* is attested from the end of the thirteenth century; the first attestation of the complete collection of the *Physics* of the *Shifâ* dates from 1338. See M.–Th. D'Alverny, 'Avicenna latinus I', *Archives d'Histoire doctrinale et littéraire du Moyen Âge* 28 (1961): pp. 284–88; S. Van Riet, 'Le *De generatione et corruptione* d'Avicenne dans la tradition latine', in

According to Averroes, Avicenna thought that the elementary forms are present in the mixture *in the same way* in which they are present in the elements. Because forms cannot undergo a variation of degrees (*non dividuntur in magis et minus*), they cannot interact directly; consequently, mixture has to happen at the level of the elementary qualities.¹⁹ Will the qualities then be kept in full or remitted? Averroes developed two arguments here.

(1) Keeping the same non-remitted qualities of an element in the mixture necessarily entails keeping its form. Keeping, say, heat and dryness, entails necessarily keeping fire too, which is nothing else than the union of heat and dryness *in summo*. And if we keep the form of the element, there will be no mixture to speak of. The missing principle here to which Averroes subscribed is that a composite substance is united in virtue of its substantial form; having distinct elemental parts *in actu* in the composite would destroy its unity and result in juxtaposition.

(2) Avicenna had proposed instead that only *remitted* qualities remain. In this case, the elemental form need not necessarily follow the qualities, because their intensity is reduced.

Averroes developed the following criticism of Avicenna's view on this point. Remission happens through a loss of ingredient parts, called *degrees (gradus)*. If we interpret the remission of qualities in terms of a subtraction of parts (or degrees), there is no obvious limit to that subtraction, and we could end up with a substance devoid of all quality. If one part can be removed, so can any other part, and so can the whole. Averroes calls this principle *pars et totum idem habent iudicium*. A substantial form devoid of all qualities, say fire without heat, is

J.M.H.H. Thijssen and H.A.G. Braakhuis, *The Commentary tradition on Aristotle's De Generatione et corruptione* (Turnhout: Brepols, 1999), pp. 69–78.

¹⁹ 'Et cum hoc latuit Avicenne, et concessit quod forme substantiales non dividuntur in magis et minus, dixit quod hec elementa non miscentur nisi secundum qualitates eorum non secundum substantias; et ex hoc contingit magnum impossibile, scilicet ut elementa sint in composito in actu propter quod compositum non habebit unam formam substantialem.' (*Comm.* 67, 227^{rb} in Averroes, *Commentaria Magna in Aristotelem. De coelo et mundo*, vol. 2, lib. II–IV, ed. by F. J. Carmody (Leuven: Peeters, 2003), p. 635).

obviously impossible. For Averroes, the substantial form necessarily entails some elemental qualities proper to that form: stripping down the qualities would leave nothing.²⁰

There is one solution left, which Averroes proposes: keep both the elemental forms and qualities remitted *secundum medietatem*. Applying remission to both elemental forms and elemental qualities is a consequence of their inseparability. Averroes's argument for keeping the elemental forms is that they need to act as intermediaries between prime matter and the final form of the mixture. Prime matter, following Averroes, cannot be informed directly by the form of the composite body, but only through the mediation of elemental forms. The elemental forms are necessary in the preparation of the matter of the mixture.²¹ Although the final introduction of the new form is the work of an external agent, the elements too act as a material cause.

Averroes's position is uncomfortable because of the generally shared principle that substantial forms do not admit variation. Substantial forms, throughout Latin Aristotelianism, are understood as simple, non-decomposable

²⁰ 'Utrum similiter [elementa] relinquuntur [in composito] in suis qualitatibus propriis suis formis aut non, verbi gratia in calore aut frigore; si autem remanent, contingit ut in composito sit ignis in actu: ignis autem non est ignis in actu nisi calore et siccitate que sunt in summo. Si autem amittant quandam partem istarum qualitatum propter mixtionem, et forme tantum remanent perfecte, possibile est ut forme eorum denudentur ab hiis qualitatibus secundum totum: pars enim et totum idem habent iudicium . . . et totum hoc est impossibile.' (Ibid.). He ends with one of his usual ad hominem attacks on Avicenna: 'paucitas vero exercitationis istius viri in naturalibus et bona confidentia in proprio ingenio induxit ipsum ad istos errores'. Duns Scotus did not think that Averroes's argument from *idem est iudicium de toto et parte* was valid (*Lect.* II, d.15, q. un., 3). He points out that, from the fact that the qualities can be remitted, it does not follow that they can be remitted *entirely*, until nothing is left but a form devoid of all qualities. Scotus argues that a substance has a minimum set of qualities without which it cannot exist.

²¹ 'Necesse est, cum ex eis generatur una forma, ut corrumpantur forme eorum secundum medietatem, quoniam si corrumpantur secundum totum, tunc prima materia reciperet primo et essentialiter omnes formas, et non reciperet formas compositorum mediantibus istis corporibus.' (*Comm.* 67, 227^{ra}).

forms that give a definition of a substance (its essence) and explain its assignation to a species. The text of reference here is Aristotle's definition of formal cause as 'an account of the essence' of a substance from *Phys.* II, 3, 194b 27. A variation of species entails a variation of forms and vice versa. How to understand then that fire is half fire in a mixt?²²

Given this constraint, Averroes is reduced to positing an intermediate ontological category for elemental substantial forms. He holds that elemental forms are not as perfect as the substantial forms of mixtures; their way of being (*esse*) is a medium between a substantial form and an accident.²³ Elemental forms, although they are *substantial* because they give the formal definition of the substance of the element, are also *accidental* because they admit a variation of degrees. The variation of forms, their 'accident-like' feature, accounts for the fact that a new form arises from their mixture, just in the way that countless median qualities arise from mixtures of other qualities (e.g., lukewarm water from cold and heated water).

The Latins criticized heavily this ontological creativity. Averroes held, as far as I understand him, the following position: elemental forms act as *substantial forms* when they inform the pure elements, but at the same time those same forms act as *accidental forms* when they inform the mixture. Elemental fire, in its pure state, has the substantial form of fire, which makes it what it is; but when combined in a mixture, say in human flesh, the elemental form of fire loses its status of substantial form and becomes an accidental form of the mixture, subordinated to the *forma mixti*: fire becomes animal heat. To sustain this argument, Averroes appeals to the distinction between *potentia* and *actus* in the

²² On substantial form as essence, see R. Pasnau, *Metaphysical Themes*, pp. 549–52.

²³ 'Si igitur aliquis dixerit quod sequitur ex hoc ut forme eorum substantiales recipiant magis et minus (et hec est dispositio accidentium non formarum substantialium . . .), dicemus quod forme istorum elementorum substantiales sunt diminute a formis substantialibus perfectis, et quasi suum esse est medium inter formas et accidentia; et ideo non fuit impossibile ut forme eorum substantiales admiscerentur, et proveniret ex collectione earum alia forma, sicut cum albedo et nigredo admiscuntur, fiunt ex eis multi colores medii.' (*Comm.* 67, 227ra–rb).

esse of the elements. When the elements are combined, their actuality is changed in the new *forma mixti*, but their potency is left intact. The substantial form of fire is *in actu* and acts as a substantial form only when it informs elemental fire; in the mixture, the same form is only present *in potentia*—that is, as an accidental form, it retains the potency of becoming a substantial form again when the mixture is resolved into its components. I base this interpretation on one of Averroes's clearer statements on the permanence of the ingredients in the mixture, to be found in his *Middle Commentary* to *De Gen.* I:

Since we have already stated that some things exist potentially while others exist actually, we see that, as far as the actual state of the miscibles at the time of their mixture is concerned, the resultant from their mixture is other than what they were before they were mixed; and as far as their potential state is concerned, each of them remains just as it was before they were mixed.²⁴

However, Averroes's claim that one and the same form can undergo a category change from accident to substance and back remains highly problematic.

Medieval Latin authors rejected the opinions of both Avicenna and Averroes unanimously. But the Arab account endured not only as a heterodox opinion against which most of the Latins could develop their variation of hylomorphism, it also gave the fundamental *causal* understanding of the combination of elements through the remission of their qualities. The remission (and intention) of accidental forms or qualities is an issue much debated in both Ancient and Latin philosophy, with a known momentum in the fourteenth century. But the form that the discussion on the intension and remission of forms took in Latin philosophy—whether the variation happens in the quality itself (Henry of Ghent) or in the

²⁴ Averroes on Aristotle's *De Generatione et corruptione*. *Middle Commentary and Epitome*, trans. by S. Kurland (Cambridge, MA: The Medieval Academy of America, 1958), p. 62.

subject sustaining the quality (Thomas Aquinas), whether variation happens at all, or what happens is a succession of different forms (Godefrey of Fontaines) or an addition of parts to the same form (Richard of Middletown, Scotus, Ockham)—is secondary here.²⁵ The lesson learned from Averroes was that the variation needed for the elements to mix happens at the level of the elemental qualities, as accidental forms. The concept of remission reduced the natural impossibility of elemental forms or qualities and made them able to combine and contribute to the introduction of the *forma mixti*. Although the Latins reacted strongly against the notion of the permanence of the elemental forms in the mixture, they all kept the causal account provided by the Arab interpretation, which entailed a permanence of qualities—until Duns Scotus.

2.3 Saint Thomas and the Latins

Aside from a couple of brief statements in his major writings, Thomas Aquinas wrote a small piece on mixture, titled *De mixtione elementorum*.²⁶

²⁵ On intensification and remission of forms in ancient philosophy, see R. Sorabji, *The Philosophy of the Commentators*, vol. 2, pp. 316–26; for the medieval discussion, see inter alia A. Maier, *Zwei Grundprobleme der Scholastischen Naturphilosophie: Das Problem der intensiven GröÙe* (Rome: Edizioni di Storia e Letteratura, 1968); E. Sylla, *The Oxford Calculators and the mathematics of motion 1320–1350* (New York, London: Garland, 1991); S. Dumont, ‘Godfrey of Fontaines and the succession theory of forms at Paris in the early fourteenth century’, in *Philosophical debates at the University of Paris in the early fourteenth century*, ed. by St. Brown, Th. Dewender, T. Kobusch (Leiden: E.J. Brill, 2009), pp. 39–125. On Scotus’s account (an addition theory), see R. Cross, *The Physics of Duns Scotus. The Scientific Context of a Theological Vision* (Oxford: Oxford University Press, 1998), ch. 10.

²⁶ *De mixtione elementorum ad magistrum Philippum de Castro Caeli*, Leonine edition, vol. 43, pp. 153–7. For other discussions of Thomas on mixture, see *Q. quod*. I, q. 4 a. 1 ad 3, *Sum. Theol.* q. 76 a. 4 ad 4, *De anima* q. 9 ad 10, *De Potentia*, q. 5, a. 7. The Leonine editors date

Thomas argues in this late text that the permanence of the elements is not realized at the level of the elemental forms at all (against Avicenna and Averroes), but at the level of their qualities or powers. Thomas thought that the Averroist intention and remission of elemental forms brings about more problems than it solves.²⁷ He thought that elemental forms are above all substantial forms (although Aristotle's own position on this matter is less than clear). As such, attributing a variation to them went contrary to a number of Aristotelian texts, expressed in the medieval dictum that forms are like numbers (*formae sint sicut numeri*).²⁸ Saint Thomas thus provided the classical argumentation against the solutions of the Arabs that would become a point of reference for subsequent treatments.

Against Avicenna's position of keeping the elemental forms, Thomas argues that it would entail a heterogeneous mixture. (1) Substantial forms need a matter properly disposed to receive them; (2) but matter cannot be at the same time properly disposed to receive the form of fire and the form of water, because these dispositions are mutually exclusive. It is impossible for prime matter to support various different elemental forms at the same time and in the same way. (3) Hence different elemental forms would have to inhere in different *parts* of matter, which means that they would have to be received in *quantified* matter (quantity

the small treatise on *De mixione elementorum* as post 1270, so I take it to be the mature expression of Thomas's views. Thomas apparently hesitated between Averroes's and his own position over the permanence of qualities; see P. Denis, 'Le premier enseignement de saint Thomas sur l'unité de la forme substantielle', *Archives d'Histoire Doctrinale et Littéraire du Moyen Âge* 21 (1954): pp. 139–64; see J.F. Wippel, *The Metaphysical Thought of Thomas Aquinas* (Washington: The Catholic University of America Press, 2000), pp. 350–1, who finds that Thomas's early sympathy for the Averroist position was ultimately rejected because of concerns over the unicity of form. See also a (non-historical) commentary of the text in J. Bobik, *Aquinas on Matter and Form and the Elements, A Translation and Interpretation of the de Principiis Naturae and the De Mixtione Elementorum of St. Thomas Aquinas* (Notre Dame: University of Notre Dame Press, 1998), pp. 103–26.

²⁷ 'Quidam autem utrasque rationes uitare uolentes, in maius inconueniens inciderunt: ut enim mixtionem ab elementorum corruptione distinguerent, dixerunt formas substantiales elementorum aliquialiter remanere in mixto.' (*De mixt. elem.*, 53–57).

²⁸ *Cat.* 5, 4a 6–9; *Metaph.* 5, 1043b 36–1044a 2 and Thomas, *In VIII Metaph.*, lect. 3.

being the accident that gives parts). (4) But a quantified part of matter joined with a form makes a complete physical body on its own, to which it would be superfluous to add another form. A multiplicity of forms in matter consequently entails a multiplicity of bodies, which invalidates the homogeneity of the mixture.²⁹

Averroes, as we have seen, wanted to avoid this consequence by defending the remission of forms. Thomas rejects this position with two arguments: (1) Holding that substantial forms undergo variation would entail that forms are divisible (one can add or extract degrees to a certain form). Divisibility in turn entails that forms participate in a continuous motion, just like qualities, by acquiring or losing degrees. However, forms cannot be gained and lost through a continuous motion, for this would invalidate the very concepts of the generation and corruption of individual substances, which happen at discrete moments. (2) The second argument: substantial forms cannot act on each other in order to get remitted because they are not, in fact, contrary to one another. Only accidents can be contrary to one another (e.g., a horse is not contrary to a cow, but a horse cannot be black and white at the same time).

Unlike substantial elemental forms, elemental *qualities* are contrary to each other and therefore can undergo intention and remission, combine and can generate a median quality. Although it inheres in the mixture, the median quality is causally produced by the combination of the extreme qualities, just like in the Arab account. In this way, the elements still act as a material cause. Thomas holds

²⁹ ‘Impossibile est enim materiam secundum idem diuersas formas elementorum suscipere; si igitur in corpore mixto forme substantiales elementorum saluentur, oportebit diuersis partibus materie eas inesse. Materie autem diuersas partes accipere est impossibile nisi preintellecta quantitate in materia, sublata enim quantitate substantia indiuisibilis permanet, ut patet in I Phisicorum [185b 11–18]; ex materia autem sub quantitate existente et forma substantiali adueniente corpus phisicum constituitur: diuerse igitur partes materie formis elementorum subsistentes plurium corporum rationem suscipiunt. Multa autem corpora impossibile est esse simul; non igitur in qualibet parte corporis mixti erunt quatuor elementa: et sic non erit uera mixtio, sed secundum sensum, sicut accidit in aggregatione corporum insensibilium propter paruitatem.’ (*De mixt. elem.*, 18–36).

that the median quality is the disposition of matter to receive the *forma mixti* (e.g., heat is a material disposition proper to receive the form of mixed fire). The difference between the median quality and the extreme qualities is not one of species, but only one of degrees; one can retrieve the original elemental forms by varying the necessary qualities to the extreme degrees. In this sense, one can also say that the elemental forms are contained ‘virtually’ in the mixture, just as Aristotle had said: the elemental qualities endure, although remitted.³⁰

Thomas’s criticism of the Arabs applied an irreducible ontological distinction between substantial forms and accidental forms or qualities that will become a standard for subsequent authors. Averroes’s thesis on the elemental forms as a medium between a substance and an accident is rejected summarily by Thomas as logically incoherent. A thing is either in a subject (an accident) or is not in a subject (a substance). A medium between a substance and an accident would entail a middle-way between the affirmation and the negation of ‘being in a subject’, which is absurd (*‘ridiculum est’*).³¹

³⁰ ‘Considerandum est igitur quod qualitates actiue et passiue elementorum contrarie sunt ad inuicem, et magis et minus recipiunt. Ex contrariis autem qualitatibus que recipiunt magis et minus, constitui potest media qualitas que sapiat utriusque extremi naturam, sicut pallidum inter album et nigrum, et tepidum inter calidum et frigidum. Sic igitur remissis excellentiis qualitatuum elementarium, constituitur ex hiis quedam qualitas media que est propria qualitas corporis mixti, differens tamen in diuersis secundum diuersam mixtionis proportionem; et hec quidem qualitas est propria dispositio ad formam corporis mixti, sicut qualitas simplex ad formam corporis simplicis. Sicut igitur extrema inueniuntur in medio quod participat naturam utriusque, sic qualitates simplicium corporum inueniuntur in propria qualitate corporis mixti.’ (*De mixt. elem.*, 123–40). See also *Sum. theol.* I^a q. 76 a. 4 ad 4: ‘Et ideo dicendum est, secundum philosophum in I de Generat., quod formae elementorum manent in mixto non actu, sed virtute. Manent enim qualitates propriae elementorum, licet remissae, in quibus est virtus formarum elementarium. Et huiusmodi qualitas mixtionis est propria dispositio ad formam substantialem corporis mixti, puta formam lapidis, vel animae cuiuscumque.’

³¹ ‘. . . ulterius procedunt, dicentes quod forme elementorum sunt imperfectissime, utpote materie prime propinquiores; unde sunt medie inter formas substantiales et accidentales, et sic, in quantum accedunt ad naturam formarum accidentalium, magis et minus suscipere

By keeping the elemental qualities in the mixture, Thomas managed to give a sense of the gradual transformation of matter: qualities act in such a way, through their reciprocal negotiation of contraries, that they prepare the introduction of the new form. Problems of hylomorphic theory aside, we can note that Thomas maintained the causal account of the generation of mixtures inherited from Arab Aristotelianism. As opposed to both Avicenna and Averroes, Thomas's view is that acting on each other in order to provoke change can happen only at the level of the qualities, not at the level of the substantial forms. Forms cannot act outside of their own species, although the qualities themselves act only in virtue of their substantial forms. The downside of this account is that it entails the separation *in actu* between qualities and substantial forms, in order to license the transmigration of qualities from the elements to the mixture. To say that the qualities remain in the mixture without the supporting forms contradicts the generally shared notion that no accident can subsist without its substantial form (unless miraculously).³²

possunt. Hec autem positio multipliciter improbabilis est. Primo quidem quia esse aliquid medium inter substantiam et accidens est omnino impossibile: esset enim aliquid medium inter affirmationem et negationem. Proprium enim accidentis est in subiecto esse, substantie uero in subiecto non esse; forme autem substantiales sunt quidem in materia, non autem in subiecto: nam subiectum est hoc aliquid; forma autem substantialis est que facit hoc aliquid, non autem presupponit ipsum. Item ridiculum est dicere medium esse inter ea que non sunt unius generis, ut probatur in X Metaphisice, medium enim et extrema ex eodem genere esse oportet; nichil igitur medium esse potest inter substantiam et accidens.' (*De mixt. elem.*, 68–89).

³² 'Qualitas autem simplicis corporis est quidem aliud a forma substantiali ipsius, agit tamen in uirtute forme substantialis; alioquin calor calefaceret tantum, non autem per eius actionem forma substantialis educeretur in actum, cum nihil agat ultra suam speciem. Sic igitur uirtutes formarum substantialium simplicium corporum in corporibus mixtis saluantur.' (*De mixt. elem.*, 140–5).

2.4 Duns Scotus's anti-Aristotelianism

Scotus is preoccupied with arguing against Averroes and, through him, against Avicenna, ignoring Thomas. This could be explained by the fact that *De mixtione elementorum* was not a widely circulated work and Thomas's account was not featured prominently in any of his major works. Because Scotus seems to ignore Thomas's solution completely, it is sometimes difficult to distinguish the differences between the two accounts, especially in what concerns the 'virtual permanence' of the elements in the mixture. However, in discussing Averroes, Scotus ends up with a parallel, distinct account, which rejects Aristotle's notion of *mixtio*.³³

I will follow Scotus's discussion on *II Sent.*, d. 15 from the *Reportata parisiensia* (*Reportatio* 2A, printed in Wadding, vol. 11, 343–5), a mature work dated from the Paris academic year 1302–1303, and the parallel discussion from the *Lectura*, edited by the Scotist Commission (vol. 19, 137–54), dated from the Oxford academic year 1298–1299 or 1300–1301. The *Lectura* offers a more

³³ Cf. Maier's report on Scotus's views, in *An der Grenze von Scholastik und Naturwissenschaft*, pp. 105–8. R. Wood, although she notes that Scotus went as far as to reject Aristotle, follows Maier's assessment of Scotus as developing the Thomist position: 'By the fourteenth century, not Averroes but Aquinas had more followers on the subject of mixture, and those followers included not only Dominicans, but Franciscans, such as John Duns Scotus and Ockham' (R. Wood, 'The influence of Arabic Aristotelianism on scholastic natural philosophy', in *The Cambridge History of Medieval Philosophy*, p. 262). Scotus's main interlocutor, when reading Aristotle, was Averroes, not Thomas. The page on mixtures from É. Gilson, *Jean Duns Scot. Introduction à ses positions fondamentales* (Paris: J. Vrin, 1952), pp. 471–2, offers a short, correct, but insufficient view. On Scotus's natural philosophy, besides Gilson, I rely on S. Prospero, *L'ilemorfismo di G. Duns Scoto: saggio* (Turin: Società Editrice Internazionale, 1955) and on R. Cross, *The Physics of Duns Scotus*.

elaborated and clear redaction than the *Reportatio*, but both texts cover essentially the same set of arguments, with some notable differences.³⁴

2.4.1 The framework of Scotus's discussion

Distinction 15 of the second book of the *Sentences* is concerned with the creation of animals in the fifth and sixth day described by the *Book of Genesis*. This topic provided an occasion to speak of the generation of mixtures from the elements. The connection may not be obvious, but commentators had to explain verses such as *Gen.* 1:20: 'producant aquae reptile animae viventis et volatile super terram sub firmamento caeli' (The Vulgate). The idea that water, a single element, can 'produce' complex mixtures by itself, such as reptiles and flying animals, would have struck an Aristotelian mind accustomed to the necessity of *four* elements as odd.

The earlier redaction of d. 15 from the *Lectura* asks a question closer to the problematic of *The Book of Genesis*: 'Whether in the body of the animal the element out of which the animal is generated remains'. The *Rep.* 2A asks the more direct question on 'Whether the elements remain in the mixture'. The frame of the discussion, the arguments *quod sic* and *quod non*, is important for determining Scotus's perspective, because he contrasts Aristotle with *The Book of Genesis*. I summarize his argumentation from *Rep.* 2A, d. 15, q. un., 1–4 in what follows (the *Lectura* gives the same set).

³⁴ A shorter version of *Reportatio* 2A, identified by the Vatican editors as *Reportatio* 2B, is not yet edited; the same goes for the part covering Book II of the *Sentences* from the *Additiones Magnae* compiled by William of Alnwick. D. 15 of Book II is part of the material that Scotus never revised for the *Ordinatio*. Wadding and other editors used to complete this part of the *Ordinatio* with text from various *reportationes* and from the *Additiones*.

2.4.2 Arguments for the claim that the elements are not kept (*quod non*).

(1) Scotus invokes here *Gen.* 1:20, on water generating fish. This should be a case of simple generation of substances, involving a corruption of the previous substance. Aristotle's dictum on continuous generation, 'the generation of one thing is the corruption of another' ('generatio unius est corruptio alterius', *De Gen.*, I, 3, 318a 23–25), also supports this basic and common understanding of change.

(2) If one element is kept, so should the other three. The elements have different natural places (e.g., fire tends upward while earth tends downward). Consequently, in the case of mixtures that float in the air, only one element would be in its natural place (fire), while the other three elements would sit 'violently' in the mixture. This should not happen to a proper stable mixture.

(3) A body composed out of contrary elements, such as the mixtures, should be able to suffer intrinsic corruption. This is not the case with gold, which endures indefinitely.

2.4.3 Arguments for the claim that the elements are kept (*quod sic*).

(1) Aristotle, in his definition of the mixture as 'a union of *altered* ingredients', says that the elements are *altered*, not corrupted (*De Gen.* I, 10, 328b 22). Therefore the ingredients are kept. Moreover, a 'union' can be applied only to existing things (it has to unite *something*: *unio est entium*).

(2) When discussing motion, Aristotle says that mixtures are moved in the direction of the predominant element (*De Coelo* I, 2, 269a 1–2); therefore they *have* a predominating element which makes them move.

(3) An argument from intrinsic corruption (*marcedo*): intrinsic corruption, as seen in organic bodies, is explained by Aristotle in terms of the mutual corruption of contrary parts within a whole (*Parva naturalia*, 5, 469b 21–3 et passim). This can be seen as a proof of elemental composition, because elements are contrary to each other.

Here the *Lectura* added another argument: the qualities of the elements appear manifestly in the mixture, but according to Aristotle, the qualities cannot be separated from their subject (*De An.* II, 11, 423a 22–7). It follows that the elements, which act as the subject for the qualities, are also present.

If the *quod sic* arguments were all taken from Aristotle, the *quod non* arguments rely mostly on *The Book of Genesis* or on natural reason. This arrangement of the arguments suggests that Scotus, in supporting the *quod non* view, will ultimately argue against Aristotle.

2.4.4 Two anti-Aristotelian theses

There are two major theses that Scotus puts forward against the Aristotelian theory of mixture: (1) that the four elements do not remain in the mixture *at all*, neither with respect to their form nor with respect to their qualities and (2) that mixtures are not generated out of the mutual interaction of the four elements *at all*; they are generated either from a single element or from another mixture.

(1) *The elements do not remain in the mixture.* This thesis is offered as a complete critique of both Avicenna and Averroes. ‘I hold that the elemental forms do not remain in the mixture, neither according to their essence, nor according to

their qualities', says the *Lectura*, and, similarly, the *Rep.* 2A: 'the substantial form of the element do not remain in the mixture'.³⁵

The principle of ontological parsimony intervenes here: there is no need to posit a plurality of substantial forms in the mixture.³⁶ From experience, there is no operation in the mixture that can be explained unequivocally by the elemental form (*Rep.* 2A, d. 15, q. un., 5 and *Lect.* II, d. 15, q. un., 21). The thesis can be easily argued for from the theory of hylomorphic composition and from the definition of the substantial form itself, as Thomas had done. The substantial form is indivisible (*atoma*) and constitutes a *per se* substance on its own. Keeping the elemental forms in the mixture would mean keeping *in actu* five supposits: one for each elemental form, plus one for the *forma mixti*. This would hardly make a *per se subsistens* (*Rep.* 2A, d. 15, q. un., 5; *Lect.* II, d. 15, q. un., 24). In the same way, one can argue on the basis of the principle that quantity is an immediate property of substance ('quantitas consequatur compositum, sicut passio substantiae corpus'). As such, quantity cannot inhere immediately in five supposits; consequently, we would have in the mixture five different quantities, a mere juxtaposition (*Rep.* 2A, d. 15, q. un., 5).

The argument against the permanence of the elemental substantial forms was acquired since Thomas. What is new, at least in the *Lectura*, is the open rejection of the permanence of the elemental qualities ('... non manent in mixto secundum suas essentias, nec eorum qualitates'). The *Reportatio* is not as vehement when it comes to this thesis. A text from the *Reportatio* suggests that Scotus could also allow for the possibility of *some* operations to be common to the element and to the mixture. Scotus notes: the natural quality of the element does not appear in the mixture, 'however, some operations appear to be common to the

³⁵ 'Ideo est alia opinio, quam teneo, quod formae elementares non manent in mixto secundum suas essentias, nec eorum qualitates'. The *Lectura* uses the word *essentia* for the substantial form. (*Lect.* II, d. 15, q. un., 27). 'Dico ad quaestionem, tenendo oppositum utrisque [i.e., Avicenna and Averroes], quod forma substantialis elementi non manet in mixto.' (*Rep.* 2A, d. 15, q. un., 5).

³⁶ Scotus admits, of course, a plurality of forms in animated beings, where they do accomplish explanatory work. See R. Cross, *The Physics of Duns Scotus*, ch. 4.

mixture and to the element, or similar to a certain degree.’³⁷ I know of no other text that supports the permanence of qualities from the elements down to the mixture in Scotus, presented here as a possibility. The *Reportatio* still argues that the elemental qualities are lost in the mixture, but it does appear that Scotus took a step back on this point. With this caveat noted, both texts are clear on the fact that the elemental qualities and the qualities of the mixture belong to *different species* altogether.³⁸ Flesh does not have the same quality that fire does, for animal heat is not the same as the heat of the fire; they are of different species, one more perfect than the other. When a new mixture is produced, new qualities are produced.

It remains for Scotus to present his own view on Aristotle’s ‘virtual permanence’ of the elements. Scotus’s explanation is that the type of relationship between the elements and the mixture is the same as that between a median quality and the extreme qualities (e.g., between grey and either black or white). Just as the extreme qualities are *virtually* present in a median quality, so are the elements *virtually* present in the mixture. They are not locally present as a thing next to a thing (*ibi res, et res*). His expression is that there is an ‘agreement’ (*conventio*) between the elements and the mixture, just as there is an agreement between the extreme qualities and the median quality. They simply *resemble* each other (*propter naturalem convenientiam* is the expression used by the *Lectura*). There is a greater similarity (*similitudo*, in the *Reportatio*) between the mixture

³⁷ ‘Ad aliud, dico quod non apparet qualitas naturalis elementi in mixto . . . tamen aliquae operationes apparent esse communes mixto et elemento vel similes in aliquo gradu.’ (*Rep.* 2A, d. 15, q. un., 6).

³⁸ ‘Dico quod non apparet qualitas naturalis elementi in mixto, sed differens specie, perfectior tamen, sicut patet primo de Anima, de calore ignis, et mixti animati, quia inanimata non augmentatur proprie, nec nutriuntur, nec calor in carne generat ignem, sed alterat ad carnem generandam, tamen aliquae operationes apparent esse communes mixto, et elemento, vel similes in aliquo gradu’. (*Rep.* 2A, d. 15, q. un., 7). ‘Dico quod qualitates elementorum non manent in mixto, immo qualitates mixti sunt alterius speciei.’ (*Lect.* II, d. 15, q. un., 39). ‘Dico quod mixtum non habet qualitatem elementi (nam caro non habet qualitatem ignis; unde calor animalis non est calor igneus).’ (*Lect.* II, d. 15, q. un., 40).

and each one of the four elements than there is between the elements themselves, which are contrary to each other (e.g., grey is closer to either black or white than black is to white).³⁹

It is tempting to see in the passages where Scotus explains that the elements remain *virtualiter* in the mixture the same doctrine as that of Thomas. The elements remain *in virtute* in the mixture (*Rep.* 2A, d. 15, q. un., 6), he says, just as the vegetative soul and the sensitive soul remain *virtute* (*Rep.* 2A, d. 15, q. un., 7) in the intellectual soul. Does it not mean that their operations, powers or virtues are kept? ⁴⁰

In light of Scotus's explanation of how it is that the extreme qualities are kept virtually in the median quality (through resemblance) and given his thesis that the elemental qualities are lost in the mixture, it seems that what he means by *remanere virtualiter* is different than what Thomas means by it. I recall Thomas's

³⁹ 'Quomodo igitur manent elementa in mixto? Dico quod sicut necesse est convenire medium eiusdem generis cum extremis, sicut vult Commentator, quod calor medius componitur ex extremis, et tamen est simplex, ita quod non plus est ibi res, et res, quam in extremo: sed pro tanto dicitur componi ex extremis, *quia est ibi convenientia cum extremo, qualis non est extremi cum alio*. Sic elementa manent in mixto, sicut in materia communi, sicut qualitates extremae in medio.' (*Rep.* 2A, d. 15, q. un., 6, my emphasis). *Lect.* II, d. 15, q. un., 27 holds the same thesis: 'Unde non est alia difficultas quomodo forma mixti potest generari ex elementis, quam quomodo qualitas media potest generari ex extremis. Sicut enim ex actione colorum contrariorum generatur forma media, in qua magis assimilantur quam inter se, quae in comparatione ad utrumque non contrariatur utrique—sic ex elementis corruptis generatur forma mixti, in quo dicuntur manere sicut in effectum communi. Unde non est alia difficultas quomodo elementa manent in mixto, quam quomodo qualitates contrariae manent in media qualitate generata.'

⁴⁰ Compare Thomas: 'Et hoc est quod Aristotiles dicit in I De generatione: Non manent igitur elementa scilicet in mixto actu ut corpus et album, nec corrumpuntur nec alterum nec ambo: saluatur enim uirtus eorum' (*De mixt. elem.*, in fine) with Scotus: 'Unde Aristoteles, quamquam videtur velle contrarium, magis videtur intentio sua pro ista parte. Dicit enim in uno loco quod actualior est forma generati, et potentialior forma elementi, ex quo. Et cum dicit quod manent elementa, subdit, *salvatur enim virtus eorum*, ideo magis videtur ponere, ipsa manere virtute, quam secundum formas proprias' (*Rep.* 2A, d. 15, q. un., 6).

phrasing for comparison. For Thomas, the elemental qualities *are found* (*inveniuntur*) in the median quality of the mixture, just as the extreme are found in the median, because the median *participates in the nature* of both extremes (*in medio quod participat naturam utriusque*).⁴¹ For Scotus, the extreme qualities and the median quality are of *different species* altogether; the extremes are not found in the median as *res et res*, although the median resembles the extremes. In short, Thomas reads Aristotle's formula 'salvatur enim virtus eorum' as entailing a permanence of *the same* qualities, although remitted; for Scotus, the virtual permanence of the elements does not entail a permanence of the same qualities; it entails only the fact that the qualities of the mixture are similar with those of the elements.

In conclusion, the *Reportatio*, as opposed to the *Lectura*, seems to allow the possibility of some qualities to endure through the mixture. This suggests the possibility that Scotus's opinion has evolved between the two redactions. However Scotus does not say that the elemental qualities are remitted or that they are kept in the mixture a remitted state, as Thomas does.⁴² They act on each other so as to generate a median quality, just as in the Arab or in the Thomist account, but once this median quality is generated, *they are gone*. They remain virtually in the median quality through resemblance. This is a significant departure from Thomas's understanding of Aristotle's *remanere virtualiter*.

(2) Scotus's second thesis is that *mixtures are not generated by the mutual corruption of the four elements*.⁴³ The mutual corruption of all four of them is in fact impossible, he argues.

⁴¹ 'Sicut igitur extrema inveniuntur in medio quod participat naturam utriusque, sic qualitates simplicium corporum inveniuntur in propria qualitate corporis mixti. . . . Sic igitur uirtutes formarum substantialium simplicium corporum in corporibus mixtis saluantur.' (*De mixt. elem.*, 137–47).

⁴² *Sum. theol.* I^a q. 76 a. 4 ad 4 quoted earlier ('Manent enim qualitates propriae elementorum, licet remissae').

⁴³ 'Ideo dico quod nunquam est necesse quod generetur mixtum ex quatuor elementis concurrentibus, etiamsi concurrant per virtutem divinam, vel qualitercumque, nunquam ex

Scotus accounts for the generation of mixtures through the simple replacement of one form with another form (since forms are the bearer of the individuality of substance in Scotus).⁴⁴ There is no difference between the generation of the mixture out of the elements and the generation of a mixture out of another mixture: in both cases it is a case of the corruption of one form and the introduction of another.⁴⁵ Scotus argues for this account from a robust understanding of substantial generation and corruption. Corruption and generation, as single processes, can involve only two participants: the corrupting agent and the corrupting patient. When water meets fire, one of them corrupts the other one; both cannot be corrupted *at the same time*. This also applies to the interaction of the four elements, which get corrupted in couples. It is a two-step process: in the first step, the elements corrupt one another in couples (e.g., fire corrupts water and air corrupts earth); in a second step, the two winning elements again act on each other, and one of them finally wins. Therefore a mixture can be generated only out of *one* element, the element that wins the final. One can say that all four elements *concur* in the generation of the mixture by selecting the element that wins, but only one of them can be the proximate cause. To say that mixtures arise from the mutual corruption of the four elements is logically inconsistent according to Scotus: in the exact moment when the form of the mixture is produced, the elements should be corrupted, and so we would have a

eis generatur mixtum.’ (*Rep.* 2A, d. 15, q. un., 6). ‘Sed istud male intelligitur ab aliquibus, ac si quattuor elementa primo agerent mutuo et se mutuo corrumperent, et tunc educerent formam aliquam intermediam eorum. Sed istud est impossibile.’ (*Lect.* II, d. 15, q. un., 28–9).

⁴⁴ On Scotus’s account of substantial form and material substance, see R. Cross, *The Physics of Duns Scotus*, chs. 2 and 5.

⁴⁵ ‘Sed materia tota fit sub forma mixti, et eodem modo fieret, si tota illa materia praefuisset sub forma unius elementi.’ (*Rep.* 2A, d. 15, q. un., 6). ‘Dicimus quod mixtum generatur ex mixto, sicut patet frequentius: animal ex animali; similiter ex uno elemento generatur mixtum, sicut ex aqua generabantur pisces et animalia volatilia.’ (*Lect.* II, d. 15, q. un., 29).

creation out of nothing. Hence Scotus declares that mixtures can be generated only out of another mixture or one single element.⁴⁶

The direct consequence of this view is that Aristotle's theory of *mixtio* as a process distinct from generation, corruption, and alteration is dropped. Scotus speaks of the *generation* of fish out of water and of the *corruption* of wood into fire, not of *mixtio*. The mixture and the element are impossible, as a *terminus ad quem* and a *terminus a quo* in a process of corruption and generation, just as the elements are impossible between themselves.⁴⁷ This rejection of the Aristotelian theory of *mixtio* is, I believe, a first in Latin Aristotelianism.

Concerning the causal relationship between the elements and the mixture, Scotus does say mixtures are generated *out of* another mixture or *out of* an element, which suggest that the elements act at the level of a material cause. The elements are by no means an efficient cause participating in the generation of the *forma mixti*, because that would invalidate the order of eminence between an element and a mixture. The argument of authority is Aristotle's principle that the cause must have at least the same degree of perfection as the effect (*De Gen.* I, 10, 237b 22–6): since the form of the mixture has a higher degree of perfection than

⁴⁶ 'Nunc autem se convenient elementa quatuor, impossibile est quod corrumpant se mutuo. Quia sint duo, A, et B, corrumpentia se mutuo, in isto instanti in quo B corrumpitur ab A, oportet A esse, aliter nihil esset corrumpens in actu; igitur in isto instanti non corrumpitur A; igitur si in alio, a B, corrumpitur A, nihil actu manente, adhuc impossibilius est quod corrumpendo se invicem generent mixtum: quia impossibile est formam mixti esse inductam ante instans corruptionis elementorum: igitur in illo instanti inducetur forma mixti ex nihilo agente.' (*Rep.* 2A, d. 15, q. un., 6). See also the same argument in *Lect.* II, d. 15, q. un., 30–2.

⁴⁷ 'Item, apparet quod mixtum corrumpitur in unum elementum, ut lignum, in ignem, et ex uno elemento potest mixtum generari, ut habetur ex Scriptura Genes. I. igitur est talis impossibilitas inter mixtum, et elementum: sicut inter terminum *a quo*, et terminum *ad quem*.' (*Rep.* 2A, d. 15, q. un., 5). 'Praeterea, mixtum generatur ex elementis, et etiam corrumpitur mixtum in elementa: potest igitur esse terminus 'a quo' et terminus 'ad quem' generationis sicut elementa inter se, quorum unum generatur ex alio et corrumpitur in illud; igitur mixtum et elementum habent impossibilitatem inter se qualem habent elementa: sicut igitur unum elementum non manet in alio, ita nec elementum manebit in mixto.' (*Lect.* II, d. 15, q. un., 23).

the elemental forms, the elemental forms cannot be the cause of the *forma mixti*.⁴⁸ But do the elements participate in the causation of the *forma mixti* in any other way?

Scotus's overall strategy goes towards weakening the causal connection between the elements and the mixture. He does so by rejecting different competing theories of the eduction of the form from matter. (1) The Augustinian theory of seminal reasons is discussed at length in d. 18 on Book II of the *Sentences*. He rejects the Augustinian (Stoic) theory that would understand the seminal reasons as inchoate forms into matter. One can say, comments Scotus, that the intermediary mixtures act as a seminal reason for the subsequent more perfect mixtures, or that the element, as a terminus *a quo*, acts as a seminal reason for the mixture; but this is not the Augustinian theory.⁴⁹ (2) The *Lectura* also argues against the more generally accepted theory of those who think that the *forma mixti* is educed from matter through the mutual corruption of the elements: it is 'a wrong understanding' of the process.⁵⁰ (3) Although he deplores those who work in vain at finding out how it is that the four elements descend from their spheres to generate the mixtures (this is not what happens at all, because the mixtures are not generated out of the four elements),⁵¹ Scotus does

⁴⁸ 'Praeter hoc necesse est agens esse aequè perfectum cum producto, nullum elementum, nec quatuor simul, sunt aequè perfecta cum mixto.' (*Rep.* 2A, d. 15, q. un., 6).

⁴⁹ *Lect.* II, d. 18, q. 1–2 (see especially 49: 'Sed quia dictum est supra quod formae elementares non manent in mixto, nec oportet materiam esse sub omnibus formis elementaribus ad hoc quod forma mixti recipiat'). See also the corresponding passage on mixtures in *Rep.* 2A, d. 18, q. 1, 13 (less developed). See a detailed account of Scotus's position on the seminal reason in R. Cross, *The Physics of Duns Scotus*, 40–5. On the Augustinian theory, see É. Gilson, *Introduction à l'étude de Saint Augustin* (Paris: J. Vrin, 2003 [1929]), p. 169ff.

⁵⁰ 'Sed istud male intelligitur ab aliquibus, ac si quattuor elementa primo agerent mutuo et se mutuo corrumpere, et tunc educerent formam aliquam intermediam eorum. Sed istud est impossibile.' (*Lect.* II, d. 15, q. un., 28).

⁵¹ 'Unde frustra laborant illi qui quaerunt quomodo elementa concurrant ad generationem mixti: aut descenderent de sphaera sua, aut aliunde.' (*Lect.* II, d. 15, q. un., 34).

accept the celestial influence on the elements and on the sublunary bodies and he does think that the skies induce forms.⁵²

The obvious alternative is that in generation a new form has to be created. The cause of the new form is relegated by Scotus to the external agent introducing the new form, acting *on* the element or *on* another mixture and generating a new substance *out of* it. An external and ‘equivocal’ (*agens aequivocum*, of a different, nobler nature) is needed to corrupt the old form and to introduce a new one. The *Lectura* appeals even to the ‘universal agent’ to introduce the *forma mixti*,⁵³ while other texts provide the sky as an example of the agent, or any other external, nobler agent. Here is a clear passage on the process:

When a mixture has to be generated out of an element (like a stone out of putrefied matter), first a certain quality appropriate for such a mixture is introduced, and at last the form of the element is corrupted and a certain form of the mixture is introduced by an agent not univocal with the generated body, by a nobler body (like the heavens).⁵⁴

The appeal to the celestial influence or to the universal agent in these passages does not mean that natural agents do not introduce forms. Forms are

⁵² ‘Utrum corpora caelestia habeant efficaciam aut aliquam influentiam super ista inferiora’ and *Rep.* 2A, d. 14, q. 3, ‘Utrum stellae aliquid agant in inferiora.’ (*Lect.* II, d. 14, q. 3).

⁵³ ‘Nam quando forma elementi unius in tantum alteratur quod non potest manere sub qualitatibus inductis ipsius alterantis ab agente aequivoco, tunc corrumpitur forma illius elementi et inducitur forma mixti ab agente aequivoco et universali, sicut quando generatur lapis et minera.’ (*Lect.* II, d. 15, q. un., 28–9).

⁵⁴ ‘Unde quando ex elemento generari debet mixtum (ut lapis aut putrefactibile), primo inducitur aliqua qualitas proportionata tali mixto, et tandem corrumpitur forma elementi, et ab agente non univoco cum generato sed a corpore nobiliore (ut a caelo) inducitur aliqua forma mixti.’ (*Lect.* II, d. 18, q. 1–2, 43).

efficacious, and any body that is nobler than the generated body can do it.⁵⁵ Scotus describes the gradual transformation of matter as a succession of forms, in a certain natural order, from less perfect to more perfect mixtures. A form can inform directly a piece of matter *quantum ad perfici*, but not *quantum ad transmutari*: in the order of transmutation, matter cannot pass directly from one form to another, it has to follow a certain order. Wine can pass into vinegar, but not the other way around.⁵⁶ The original element or mixture has to be properly disposed to receive the new form of the generated mixture, and not another form. In this sense, the causal contribution of elemental matter in the generation of the mixture is saved at the level of the material cause: an anterior material transformation is necessary for the reception of any form, both to enable and to limit the in-formation.⁵⁷

⁵⁵ On causation in Scotus, see especially É. Gilson, *Jean Duns Scot*, pp. 343–55, 630, *passim*, (see p. 630, on essentially ordered causes: ‘Chaque être second reçoit donc du Premier, par mode de création, une efficace causale proportionnelle à son être’); see also Cross, *The Physics of Duns Scotus*, ch. 3 and M. Sylwanowicz, *Contingent Causality and the Foundations of Duns Scotus’s Metaphysics* (Leiden, New York, Cologne: E.J. Brill, 1996).

⁵⁶ ‘Dico quod immediatio formae ad materiam est duplex, vel *quantum ad perfici*, vel *quantum ad transformari*. Primo modo, dico quod forma substantialis immediate recipitur in materia quacunque indifferenter, ita quod immediate. Secundo modo, non immediate, quia ordo est formarum inter se, ita quod aliquae sint priores, aliquae posteriores, ita quod materia non immediate transmutatur a quacunque forma ad aliam, sed ordine quodam; ut immediate post formam vini formam aceti, non autem e contra.’ (*Rep.* 2A, d. 15, q. un., 9). Scotus argues here against Averroes’s objection, mentioned earlier, that the forms of mixtures cannot be received immediately in matter, but only through the mediation of elemental forms.

⁵⁷ Cf. on this point É. Gilson, *Jean Duns Scot*, p. 434, who argues that, for Scotus, attributing a certain degree of actuality to matter is what makes generation and corruption possible.

Conclusion

Scotus's theory of mixtures was not inconsequential. Some of his immediate followers, like Peter of Aquila, copy him indiscriminately.⁵⁸ One important follower is Ockham, who defended Scotus's thesis over the non-permanence of qualities and affirmed, similarly, that the elemental qualities are replaced by equivalent qualities in the mixture.⁵⁹ Thus Scotus's 'resemblance' thesis over Aristotle's *remanere virtualiter* would live on, and one can follow his posterity through Maier's study.⁶⁰

After having studied an impressive amount of material on the theory of mixture, Maier's conclusion was that Aristotelianism could not provide a successful solution because hylomorphism was incompatible with the theory of the Empedoclean elements. Aristotelianism was from the start a failed project, and the two parallel descriptions of matter were never rendered fully integrated by Latin authors, according to Maier. She expressed this structural incompatibility as that between a metaphysical doctrine (hylomorphism) and a natural

⁵⁸ *Fr. Petri de Aquila Commentaria in quatuor Libros Sententiarum magistri Petri Lombardi*, ed. by C. Paolini, 4 vols. (Levanto: Conv. Ssmae Annuntionis, 1907–1909), vol. 2, pp. 261–6. Most of Peter's account is taken almost literally from the *Lectura*.

⁵⁹ 'Tertio dico quod sicut forma elementaris substantialis non manet in mixto, ita nec qualitates eorum manent in qualibet parte mixti . . . Quarto dico quod elementa dicuntur manere in mixto quia qualitates aequivalentes qualitatibus elementorum manent.' (*Quodl.* III, q. 5, in *Opera Theologica*, vol. 9, p. 222). I read Ockham's next explanation on this page, that some elemental qualities 'remain' in every part of non-animated bodies, while they 'remain' only in some parts of animated bodies, to entail that they 'remain' in the qualified sense explained above, as replaced by equivalent qualities of the mixture. Otherwise it seems incoherent with his previous statements.

⁶⁰ A. Maier, *An der Grenze von Scholastik und Naturwissenschaft*, p. 109ff.

philosophical doctrine (theory of elements). Maier also thought that this failure paved the way for the seventeenth-century rejection of hylomorphism and the success of corpuscularian and atomistic theories.

Maier's assessment was reminiscent of Duhem's strong opposition between hylomorphism and atomism as the two irreducible alternatives for any theory of mixture.⁶¹ As Paul Needham has shown, one should add a third alternative theory of mixture to Duhem's and Maier's opposition between Aristotelianism and atomism: the Stoic one, which paralleled the development of Latin Aristotelianism and enjoyed a certain revival in the Renaissance and in the seventeenth century. Additionally, recent literature has challenged Maier's view according to which an Aristotelian account of mixtures was simply not possible. Rega Wood and Michael Weisberg have argued that Rufus of Cornwall's theory of mixture satisfied the demands of an Aristotelian theory, and his account was followed by a number of other figures.⁶²

In this sense, Scotus is not a success story that should count against Maier's view, because his account rejects the Aristotelian *mixtio* altogether in favour of generation and corruption. The reassessment of Duns Scotus's account of mixture tells us that the structural problems with the Aristotelian theory, which Maier believed were insoluble, were recognized by one major figure. But it also tells us that the rejection of the Aristotelian theory need not be in favour of atomism, or the Stoa for that matter. Scotus still works within the Aristotelian frame of concepts and his account is forged by rigorously determining their use

⁶¹ P. Duhem, *Le mixte et la combinaison chimique. Essai sur l'évolution d'une idée* (Paris: C. Naud, 1902, reprinted Paris: Fayard, 1985). See now P. Needham's studies on Duhem, especially his 'Duhem's theory of mixture in the light of the Stoic challenge to the Aristotelian conception', *Studies in History and Philosophy of Science Part A* 33 (2002): pp. 685–708. For Maier's conclusions, see esp., *An der Grenze von Scholastik und Naturwissenschaft*, pp. 3–4 and 138–40.

⁶² R. Wood and M. Weisberg, 'Interpreting Aristotle on mixture: problems about elemental composition from Philoponus to Cooper', *Studies in History and Philosophy of Science Part A* 35 (2004): pp. 681–706. J.M. Cooper, 'Two notes on Aristotle on mixtures', provides a defence of Aristotle's own account of mixtures.

and internal coherence.⁶³ Scotus's rejection of *mixtio* derives ultimately from his understanding of substantial form as an irreducible, inflexible individual: change happens through a succession of individuals, and what endures through change is matter, not form, be it substantial or accidental.⁶⁴ The fact that an account of mixture was given while using both hylomorphic theory and the theory of elements suggests that the two doctrines need not be seen as fully incompatible.

⁶³ É. Gilson notes, with his usual penetration, on the real distinction: 'Toute son habitude de pensée [Scotus's], qui l'incline à la multiplication des moments dans l'analyse, lui fait en revanche éliminer du concret les distinctions réelles chaque fois qu'il peut les éviter. Nous en aurons des preuves, mais aucune plus décisive que sa doctrine du mixte'. *Jean Duns Scot*, p. 471.

⁶⁴ See a discussion of this in R. Cross, *The Physics of Duns Scotus*, p. 43ff., who speaks of 'the principle' that 'it is not possible that change occurs without the production and/or destruction of an individual thing.'

3 Péter Pázmány and the sixteenth-century exegesis of *Meteorologica* IV

After having proposed a rectification to Anneliese Maier's history of the theory of mixtures in Latin Aristotelianism in the previous chapter, this chapter discusses Maier's main thesis: that hylomorphism was incompatible with the theory of elements. It does so by presenting Péter Pázmány's theory of mixtures and his efforts of establishing a doctrinal coherence for Aristotle's *Meteorologica*. The chapter discusses two problems: (1) the placement of *Meteor.* IV in the Jesuit course on physics and (2) the conceptualization of putrefaction as a type of substantial mutation. Through an analysis of these issues, it shows how sixteenth-century exegesis imposes the hylomorphic thesis onto the subject matter of meteorology and how the hylomorphic theory of substantial change can be adapted in order to accommodate the theory of elements. The case being made is that *Meteorologica* is a privileged place where hylomorphism and the theory of elements meet and that late Aristotelian theory of mixtures sought to accommodate both theories of material substance.¹

¹ This chapter is based on 'Hylomorphism versus the Theory of Elements in Late Aristotelianism: Péter Pázmány and the Sixteenth-Century Exegesis of *Meteorologica* IV', *Vivarium* 52 (2014): pp. 1–26.

3.1 The tension between hylomorphism and the theory of elements

As mentioned in the previous chapter, Maier's thorough study of 'the structure of material substance' in Latin Aristotelianism remains the only extended study of this problem to date, and yet its implications have rarely been discussed.² Aristotelianism, following Maier, conceived of material substances in two ways: on the one hand, bodies are composites of matter and form, but on the other, they are also mixtures of the four elements, earth, water, air and fire. Maier saw an irreducible incompatibility between these two views. Her strong thesis is that medieval philosophy never succeeded in conciliating Aristotle's hylomorphism with his doctrine of mixtures.³

Before Maier, Pierre Duhem had already suggested two opposite and conceptually exhaustive ways of thinking about the nature of mixtures: 'atomistically', which looks for the ingredients of the mixture (and in doing so, understands mixtures as aggregates of these ingredients), and 'peripatetically', which sees mixture as a substance ontologically distinct from its ingredients.⁴ Maier's work went further and placed this tension within Aristotelianism itself: there is a hylomorphic way of thinking about mixtures, concerned with generating

² 'Die Struktur der materiellen Substanz', in *An der Grenze von Scholastik und Naturphilosophie*, op. cit.

³ 'Die Scholastik hat nämlich nicht vermocht, für die Konstitution der materiellen Substanz, so wie sie sie zur Voraussetzung ihrer ganzen Naturbetrachtung und Naturerklärung machte, eine Deutung zu finden, die mit den Grundlagen ihrer Metaphysik in Einklang stand.' (*An der Grenze*, p. 3). 'Die Scholastik hat das Problem nicht gelöst, weil es für sie nicht lösbar war' (Ibid., p. 138), *passim*.

⁴ P. Duhem, *Le mixte et la combinaison chimique*, pp. 11–15.

and specifying the substantial form of the compound, and there is also an elemental way, concerned with specifying the composition of the compound, what it is made of and how can it be decomposed into its ingredients.

Maier showed the failure of medieval exegesis to resolve this tension in the much-debated question *utrum elementa maneat in mixto*, discussed in the previous chapter: how are the forms of the elements kept in the compound, given that the compound should have its own form, but also that it should be able to resolve itself into the composing elements? Maier thought it was a problem of the ‘system’ itself, resolved only by the seventeenth century’s revival of the atomistic view of mixtures.⁵

An irreducible internal conflict in the Aristotelian concept of material bodies suggests that the problem would manifest itself in various places in the commentary tradition. Following Maier’s lead, I look for this tension in the sixteenth-century commentary on *Meteorologica*, taking it as a privileged place for discussions of matter theory and the theory of mixtures. The *Meteorologica* books deal with processes of gradual elemental transformation and with complex bodies—bodies that most of the time cannot be treated as Aristotelian individual substances and are recognized as aggregates. The meteors, as defined by the *Meteorologica* tradition, are precisely bodies ‘on the way of being mixed’, not yet full mixtures, but not pure elements either.⁶ I will show how the sixteenth-century conception of mixtures relies on both theories of material substance, and I

⁵ ‘Es ist eines der Beispiele, wo jener Prozess der allmählichen aus inneren Motiven erfolgenden Lockerung und Auflösung der mittelalterlichen Weltanschauung—der sich ja im 14. Jahrhundert auf vielen Gebieten beobachten lässt—an einem Einzelfall sichtbar und begreifbar wird. Und zwar an einem Einzelfall, der grundsätzliche Bedeutung hat, eben weil an ihm in erster Linie sich die grosse Wandlung vom mittelalterlichen zum modernen naturwissenschaftlichen Weltbild vollzogen hat, und weil diese Wandlung zu einem wesentlichen Teil vorbereitet wurde durch das Versagen der Scholastik diesem Problem gegenüber.’ (*An der Grenze*, pp. 3–4).

⁶ I take the expression from Albertus Magnus’s definition of the meteor as a simple body ‘prout est in via ad commixtionem’. *Opera omnia*, ed. by A. Borgnet, 38 vols. (Paris: L. Vivès, 1890–1899), vol. 4, p. 478a.

maintain that the best strategy for reducing the tension—at least, the best available to the late-sixteenth-century commentator preoccupied with the coherence of Aristotle’s corpus—was to impose the hylomorphic thesis onto texts where Aristotle himself makes little use of it. I hold, with Maier, that the tension between hylomorphism and the theory of elements is real in the sense that it is consciously perceived as such by commentators when confronting Aristotle’s text. But I also hold (and here I differ from Maier’s more rigid conclusions) that late-sixteenth-century Aristotelianism is flexible enough to accommodate both theories, although doing so meant sometimes straying considerably from Aristotle’s text, in a careful heterodoxy.

My engagement with Maier is not concerned with the conclusions of her investigation of material substance. It may very well be an inherent incoherence in the Aristotelian conception of sublunary bodies. But the material I use shows also a search for coherence that merits assessment. I want to think further about the meaning of this incompatibility for Aristotle’s ‘system’ as it was understood in the scholastic exegesis and pedagogical culture of the sixteenth century, a setting where Aristotle’s *littera* came under heavy scrutiny.

It is well known that the sixteenth century witnessed unprecedented attacks on core Aristotelian doctrines, with such attacks coming from various directions, and most of the time from within the plurality of Aristotelianism itself. The metaphysics of matter and form inherited from the fourteenth century had little to do with Aristotle anymore.⁷ It is also known how resilient to change the Aristotelian university course on physics was, and there is little room for illusions about its rigidity. My question, then, is this: how important was it for Aristotelian exegesis to maintain compatibility between hylomorphism and the theory of elements in the analysis of mixtures? Given that the theory of elements will ultimately win, on this point, in the seventeenth century, at the expense of hylomorphism, what kept the two theories together in Aristotelian physics?

⁷ For the history of hylomorphism in Latin Aristotelianism, see D. Des Chene, *Physiologia*, and R. Pasnau, *Metaphysical Themes*.

In the first part of the chapter, I look at the extent to which sixteenth-century ‘meteorology’ is indebted to hylomorphism, and in what way the pedagogical exegesis to Aristotle’s *Meteorologica* reinforced the hylomorphic thesis while defining its subject matter.

In the second part of the chapter, I look at the problem of generation and corruption as posed by the theory of mixtures. Hylomorphism is not only a theory about the structure of bodies, but also, more importantly, a theory of change. As such, it comes together with a theory of the generation and corruption of individual bodies. I will thus look for the way in which the theory of mixtures accommodates both the hylomorphic model of change and elemental theory.

While taking into account other figures, the focus of my discussion will be on the work of the philosopher Péter Pázmány (1570–1637) and his lectures on Aristotle’s *Meteor.* IV. Pázmány is important in several ways: he is the leading Counter-Reformation figure in Central and Eastern Europe; he is a well informed and commendable philosopher in his own respect, who has been unduly neglected by the historiography; and he offers a well-articulated viewpoint on the way in which the Jesuit university course was developing at the end of the sixteenth century, particularly in response to challenges posed by the bolder exegesis of Veneto humanism.

The philosophical reader may need a short biographical summary. Péter Pázmány’s brief but numerous philosophical writings have received relatively little scholarly attention outside of Hungary, although he is well known through his theological, political and missionary activity.⁸ He was born in 1570 in

⁸ See P.R. Blum, ‘Péter Pázmány: The Cardinal’s philosophy’ in his *Studies on Early Modern Aristotelianism*, op. cit., pp. 51–65. The Hungarian literature on Pázmány is extensive. See J. Adonyi and I. Maczák, *Pázmány Péter-bibliográfia: 1598–2004* (Piliscsaba: PPKE BTK, 2005), supplemented with E. Hargittay and I. Maczák, ‘Pótlások a Pázmány Péter bibliográfiához’, *Acta Historiae Litterarum Hungaricanum* 30 (2011): pp. 160–83. A commented bibliography in English up to 1970 can be found in A. Tezla, *Hungarian Authors. A Bibliographical Handbook* (Cambridge, MA: Harvard University Press, 1970), pp. 455–61. (I thank Vlad Alexandrescu and Dániel Schmal for references to the Hungarian bibliography.) See also, in English, P. Schimert, *Péter Pázmány and the reconstitution of the Catholic*

Oradea/Nagyvárad, in the Principality of Transylvania, and was baptised in the Orthodox Church. He converted to Catholicism as a child, either as a result of Jesuit missionary efforts or through the influence of his stepmother, who was a Catholic herself. He studied at the Oradea seminary and then at the newly founded Jesuit College in Cluj-Napoca. Entering the Society, he completed his noviciate in Kraków, his philosophy studies in Vienna and his theology studies in Rome. Before launching a successful theological and ecclesiastical career (archbishop and Primate of Hungary, he was the third Jesuit to be incardinated, after Toledo and Bellarmine, in 1629), Pázmány taught philosophy for three years at the newly founded 'Academy' of Graz, from 1597 to 1600.⁹ He published a number of philosophical disputations written during those years,¹⁰ and also wrote a notable philosophy course. Towards the end of his life, he started to prepare this course for publication as a manual for the university of Nagyszombat (Trnava), but he died before completing the project. The material on *Meteor.* IV that I am concerned with is part of this university course, composed of several disputations held in class on topics from Aristotle's texts. An appended note will propose a more precise dating for these disputations.

aristocracy in Habsburg Hungary, 1600–1650, PhD thesis (University of North Carolina at Chapel Hill, 1989). Pázmány's works are published in two series as *Péter Pázmány Összes munkai, Magyar sorozat* [Collected Works, Hungarian Series], 7 vols. and *Petri cardinalis Pázmány Archi-episcopi Strigoniensis et primatis regni Hungariae Opera omnia, Series Latina*, 6 vols. (Budapest: typis Regiae Scientiarum Universitatis, 1894–1905). Hereafter *Opera* refers to this Latin series.

⁹ The last decades of the sixteenth century were years of fast and extremely successful re-Catholicisation for Eastern Europe. The Jesuit college of Graz was founded in 1578, in what was initially a largely Protestant city, and transformed into a university by the Archduke Karl II in 1586.

¹⁰ These disputations are re-edited in *Grazer philosophische Disputationen von Péter Pázmány*, ed. by P.R. Blum and E. Hargittay (Piliscsaba: Katholische Peter-Pázmány-Universität, 2003).

3.2 The placement of *Meteorologica* IV in the Jesuit physics course

Meteorologica is not a text to which medieval literature devoted excessive attention, in comparison to other areas of the Corpus Aristotelicum. Moreover, the idea that the fourth book of *Meteorologica* should be separated from the first three has always been a suspicion in the exegesis, because the discontinuity between the texts is striking. *Meteor.* I–III deal with meteors proper as formed by vapours and exhalations; *Meteor.* IV speaks chiefly about the work of elemental qualities (hot, cold, wet and dry) and ends in a theory of organism. Early modern scholars have also noted the separate career of Aristotle's *Meteor.* IV in the corpuscularian and alchemical traditions.¹¹ With the re-appropriation and

¹¹ C. Lüthy, 'An Aristotelian Watchdog as Avant-Garde Physicist: Julius Caesar Scaliger', *The Monist* 84 (2001): pp. 542–61; W.R. Newman, 'Corpuscular Alchemy and the Tradition of Aristotle's *Meteorology*, with Special Reference to Daniel Sennert', *International Studies in the Philosophy of Science* 15 (2001): pp. 145–53; *Aristoteles chemicus. Il IV libro dei 'Meteorologica' nella tradizione antica e medievale*, ed. by C. Viano (Sankt Augustin: Academia-Verlag, 2002). The authenticity of *Meteor.* IV was strongly questioned at the beginning of the twentieth century on grounds that it was too 'mechanistic'. Overviews of the debate can be found in C. Baffioni, *Il IV libro dei 'Meteorologica' di Aristotele* (Naples: Bibliopolis, 1981), pp. 34–44, C. Viano, *La matière des choses: le livre IV des Météorologiques d'Aristote et son interprétation par Olympiodore* (Paris: J. Vrin, 2006), pp. 17–23, and E. Lewis, 'Introduction' to Alexander of Aphrodisias, *On Aristotle's Meteorology* 4, (Ithaca, NY: Cornell University Press, 1996), pp. 3–15. The first to express doubt over the authenticity of the book is Francesco Patrizzi, *Discussiones peripateticae* (Basel: ad Perneam Lecytum, 1581 [first edition Venice, 1571]), pp. 116–17. For the Jesuit literature on *Meteorologica*, see F. de Dainville, *La Géographie des humanistes*.

printing of later Greek commentaries on *Meteorologica* in the Renaissance, the question of the discontinuity of *Meteor.* IV became more acute. Alexander of Aphrodisias' suggestion to displace the book and attach it to *De Gen. et corr.* (h. 179, 1–11) was discussed widely, and a renewed interest for *Meteor.* IV developed.¹² Philological discussions turned naturally into discussions over the subject matter of 'meteorology' itself.

Alexander's proposal, advanced with the argument that *Meteor.* IV deals with the powers of elemental qualities treated in *De Gen. et corr.*, was followed by a number of authors. The widely circulated commentary of Francesco Vicomercato, which followed Alexander in this respect, contributed to a large extent to the diffusion of the separation thesis.¹³ By the late sixteenth century, this had become a hot topic, and treatises that dealt specifically with *Meteor.* IV, separated from the other three books, began to accumulate, while the rest of the meteorological literature tended to limit itself to the first three books, excluding the fourth. The seventeenth century inherited this outcome. This division of Aristotle's *Meteorologica* books, with the displacement of *Meteor.* IV, is an under-researched feature of the historiography of early modern theories of matter.¹⁴

The exegetic discussion around *Meteor.* IV reveals an interesting effort of accommodating hylomorphism and theory of elements. I will take a closer look at

¹² See Alexander of Aphrodisias, *On Aristotle's Meteorology 4* and idem, *Commentaire sur les Météores d'Aristote. Traduction de Guillaume de Moerbeke*, ed. by A. J. Smet (Louvain: Publications universitaires and Paris: Bêatrice-Nauwelaerts, 1968). Besides Alexander's position, known since the thirteenth century, Olympiodorus recalls Ammonius for the opinion of keeping the book in its fourth place and argues that the treatment of metals and minerals from the end of Book III prompts the treatment of homeomerics in general from Book IV. Philoponus's commentary to Book IV did not survive, but he, like Olympiodorus, noted the continuity between the study of metals at the end of Book III and the material from Book IV. See E. Lewis, 'Introduction', loc. cit.

¹³ Francesco Vicomercato, *Commentarii in IV libros Meteorologicorum* (Venice: M. Vascosan, 1556).

¹⁴ See C. Martin, 'Francisco Vallés and the Renaissance Reinterpretation of Aristotle's *Meteorologica* IV as a Medical Text', *Early Science and Medicine*, 7 (2002): pp. 1–30, for details on the career of *Meteor.* IV in the sixteenth century and references to sources.

the arguments through the eyes of Péter Pázmány. Pázmány was very much aware of the debate and of the recent contributions to it; attentive of Paduan and Roman developments, he made use of the most significant recent authors to have written on *Meteor.* IV: Pietro Pomponazzi, Francisco Vallés, Agostino Nifo, Francesco Vicomercato or Giacomo Zabarella. His argument for the unity of the *Meteorologica* books is typical, and it shows how discussions over the placement of one of Aristotle's books in the corpus decide philosophical issues over the structure of matter.

Pázmány lectured on *Meteorologica* in 1598 and 1599: two disputations on the fourth book and a 'treatise' on the first three books, already dividing the material (*Opera* 3:415–552, see my appended note on the dating). For him, meteorology is the beginning of what could be called 'applied physics', (what other authors around that time start to call *physica specialis*).¹⁵ After having laid out the general principles of natural generable bodies in the *Physica* and those of substantial transformation in the books on *De Generation et corruptione*, the course continues with investigations meant to demonstrate the principles enunciated earlier through their natural effects, an *a posteriori* demonstration.¹⁶

Pázmány starts off by reporting on Alexander and Vicomercato, who argue for the attachment of *Meteor.* IV to *De Gen. et corr.* on the account that the book deals with the operations of elemental or primary qualities, and only 'accidentally' with mixtures, insofar as mixtures are the result of the said operations. This view puts more weight on the hylomorphic theory, insisting on the operations of qualities as forms of bodies. Pázmány proposes, on the contrary, that *De Gen. et corr.* deals with primary qualities insofar as they are properties of the elements, whereas *Meteor.* IV deals with qualities insofar as they are passions of mixed

¹⁵ 'Inter philosophiae naturalis partes unam esse diximus initio Physicae . . . quam Aristoteles libris meteorologicis explicavit'. (*Opera* 3: 454).

¹⁶ 'Nostra sententia, quam quod omnia tractata his libris [Phys.] sunt principia, causae, passionis corporis naturalis generabilis, non ut hujus vel illius speciei sunt, sed solum ut sunt corpora generabilia'. (*Physica*, in *Opera* 2: 14).

bodies.¹⁷ This view puts more weight on the theory of elements, insisting on the difference between pure elements and mixtures. Going from *De Gen. et corr.* to *Meteor.* IV would thus mark a passage from the principles of the constitution of matter (the elements) to the material bodies themselves (individual mixtures), from a *physica generalis* to a *physica specialis*. One can therefore define a field of study—‘meteorology’—based on its own object of study, natural mixtures. The first three books of *Meteorologica* deal with imperfect mixtures, while the fourth deals with perfect mixtures; together they compose a complete treatise on inanimate sublunary bodies.

But does the book stay true to this object of study? This leads us to the next disputed argument of the exegesis: whether *Meteor.* IV deals with meteorological bodies or not (*Opera* 3: 415–16). Alexander and Vicomercato, as expected, do not consider the book’s subjects ‘meteorological’ (*meteorologicus*). According to this opinion, the unity of *Meteor.* I–III would be given by the fact that Aristotle deals with bodies from the lower atmosphere (*in sublimi*) that have a common matter (the double *halitus*, the vapours and exhalations that make up the meteors in Aristotle’s theory). This common matter, extensively used in *Meteor.* I–III, does not play a role in *Meteor.* IV. And then there are conceptual advantages for the separation: Alexander’s solution would make of *De Gen. et corr.* a complete and ‘coherent’ treatise on all the substantial transformations that mixtures can suffer. More importantly, without the treatment of the substantial transformations from *Meteor.* IV, some of the discussions from *Meteor.* I–III would be unintelligible: one cannot understand hail without congelation, nor the generation of stones without concretion.

For the arguments *pro*, Pázmány brings in the bulk of the commentary tradition to *Meteor.* IV as authorities, overwhelmingly in favour of keeping the inherited structure of *Meteorologica* books (Philoponus, Olympiodoros, Averroes,

¹⁷ ‘Sed [Alexander et Vicomercatus] decipiuntur . . . tum quia Aristoteles explicat hic operationes primarum qualitatum quatenus sunt passionis mixtorum, sicut in lib. De generat. explicatae sunt primae qualitates quatenus sunt proprietates elementorum.’ (*Opera* 3: 415).

Albertus Magnus, Saint Thomas, Timaeus (?)¹⁸, together with more recent authors such as Pomponazzi or Boccadiferro. Their view rests on somewhat forcedly assigning the common matter from *Meteor.* I–III to the mixtures of *Meteor.* IV: even if the two types of exhalations are not as present in this fourth book as in the first three, the mixtures dealt with here actually have the same material origin. They are ontologically the same type of bodies because they are made up of the same stuff, so they should be treated in the same manual.

This is a typical classroom disputation that offers a compendium of arguments together with the master's preference. There is a fine line between pure dialectics and the expression of attachment to one side or the other. But the discussion does decide one thing: meteorology is defined as a science of mixtures, having its own unity within the Aristotelian corpus. It need not deal with bodies of the upper atmosphere,¹⁹ but with bodies of a certain type: whether aggregates (*Meteor.* I–III) or perfect compounds (*Meteor.* IV), they compose a science of natural mixtures directed by the theory of substance transformation from *De Gen. et corr.*

I claim that, in this discussion about the nature of this field of study, we can read an imposition of the hylomorphic thesis onto Aristotle's material. What I characterize as an imposition is the definition of meteorology as dealing with *imperfect* and *perfect* mixtures. Aristotle did not speak of perfect or imperfect mixtures (I would go so far as to say that the concept of an imperfect mixture, not yet a mixture and still not an element, goes against Aristotle's metaphysics of substance), and the concept is an elaboration of the medieval tradition. Pázmány deals with the distinction between perfect and imperfect mixtures in his fourth disputation on the *De Gen. et corr.* from the same teaching course, titled *De mixtione*. It is based on a hylomorphic criterion: if the new body receives a new substantial form, it is called a perfect mixture, it follows under the species of

¹⁸ Presumably a corruption of Themon (Thimo) Judaeus, the fourteenth-century author of questions on *Meteorologica* that we have discussed in chapter 1.

¹⁹ 'Tertio, ratio cur negant hunc librum esse meteorologicum est quia quae hic tractantur non generantur in sublimi. At hoc nihil valet, nam non ea sola hic tractantur, sed quae constant duplici halitu, qualia sunt hic explicata.' (*Opera* 3: 417).

substantial generation, and it will be dealt with in *Meteor.* IV; if the new body does not receive a new substantial form, but only accidents, it is called an imperfect mixture and will be dealt with in *Meteor.* I–III. *De Gen et corr.* lays down just the process itself.²⁰

This is a commonly held opinion in the sixteenth century, and not only. Current scholarship traces the division between perfect and imperfect mixtures back to fourteenth-century discussions.²¹ However, this is not a late medieval innovation, but one that builds on earlier decisions. Albertus Magnus, in his commentary, speaks of two ways in which the simple mobile body is considered in *Meteorologica*: (1) from the point of view of the path towards mixture (*ex parte viae commixtionis*), which is the material dealt with in Books I–III, or (2) from the point of view of the mixture itself (*ex parte ipsius commixtionis*), which is the material dealt with in Book IV.²² By the time we get to Duns Scotus, we already

²⁰ ‘Mixtio interdum significat corporum diversae rationis secundum minutas partes factam confusionem, ut fit cum cinis farinae, aqua vino miscetur. Et haec non sunt inter se unita ita ut unam entis speciem constituent. Aliquando sumitur pro mixtione imperfecta qualitatum in qua non producitur nova forma substantialis distincta a formis elementorum, sed nova tantum accidentia, ut fit in mixtis imperfectis vapore et exhalatione quae non habent formam mixti diversam a formis elementaribus. Aliquando demum sumitur pro mixtione perfecta per quam producitur forma substantialis mixti de novo sive remaneant formae elementorum, sive non.’ (*De Gen. et corr.*, in *Opera* 3: 389).

²¹ C. Martin, *Renaissance Meteorology*, p. 159, n. 3 attributes ‘one of the first’ occurrences of the term ‘imperfect mixtures’ to Buridan’s *Expositio libri meteororum* (unedited).

²² ‘Mobile autem simplex prout est in via ad commixtionem, determinatur in isto libro quem habemus prae manibus, qui dicitur *Meteororum*, qui continet secundam partem naturalis philosophiae. Mobile autem huiusmodi consideratur dupliciter, scilicet ex parte viae commixtionis, quae est secundum quod unum elementum movetur in regione alterius per hoc quod alteratur ad ipsum per vaporem vel inspissationem: vel consideratur ex parte ipsius commixtionis, quae fit per activam qualitatem unam vel plures, vel per passivas. Et mobile quidem simplex primo modo consideratum, determinatur in primis tribus libris Meteororum. Mobile autem simplex secundum modum commixtionis factae per activas vel passivas qualitates, determinatur in libro 4. huius scientiae.’ (*Opera omnia*, op. cit., vol. 4, p. 478a).

have the full doctrine. In a *Sentences* discussion over baptismal water, requesting it to be pure and not mixed, Scotus puts forward the view as follows:

But making a mixture can be understood in two ways: in one sense, that from the mixed things a third thing is made one per se, or a perfect mixture, like at the end of the process of mixture, when bodies are composed of the four elements; or [in another sense it can be understood that] an imperfect mixture is made, in the process of becoming a perfect mixture, like the meteors of hail or snow.²³

This is the first occurrence of the theory of perfect and imperfect mixtures that I have been able to find, but the context suggests that it was not something new in Scotus' time. In late medieval discussions, the notion of *imperfecta mixta* as the subject matter of meteorology is omnipresent. The interplay of perfect and imperfect mixtures in the same book, separated ontologically into aggregates 'in

²³ 'Sed mixtionem fieri, potest intelligi dupliciter: uno modo, quod ex mixtionibus fiat aliquod tertium per se unum, sive fit perfecte mixtum, ut in termino mixtionis, ut sunt composita corpora ex quattuor elementis, vel imperfecte mixtum, et in via ad perfectam mixtionem, cuiusmodi sunt impressiones gradinis et nivis. (*Rep. paris.* IV, d. 3, q. 3, in *Opera omnia*, Wadding-Vivès edition, vol. 23, p. 585a–b). Cf. a less explicit text in *Ordinatio* II, 8, q. un., in *Opera omnia*, Vatican edition, vol. 8, p. 126–7. The question here is, which type of body can an angel assume? In cases where the angel assumes a body that is not caused by natural causes, like Raphael, i.e., a body formed temporarily just for the angel's incarnation, that body can only be imperfectly mixed: 'videtur probabile quod illud sit corpus mixtum . . . sed non mixtum plena mixtione . . . Itaque corpus, quod ita quasi subito formatur et resolvitur, est mixtum imperfecta mixtione.' Scotus' test for a body to be imperfectly mixed is immediate corruption: if the body is immediately resolved into its composing elements, then that body was an *imperfectum mixtum*; otherwise it would have passed through an intermediary stage, like the cadaver. The doctrine seems to be that the less stable a nature is, the more imperfect it is. See chapter 2 on Duns Scotus.

via' towards perfect mixtures and 'complete bodies', will endure well into the seventeenth century. The distinction will remain, to my knowledge, undisputed in the meteorological literature until Descartes's *Météores* of 1637 (see chapter 5). It is manifest for instance in Jean Baptiste Du Hamel's popular title from the second half of the seventeenth century: *De meteoris et fossilibus: libri duo: in priore libro mixta imperfecta quaeque in sublimi adhere vel gignuntur vel apparent fusè pertractantur: posterior liber mixta perfecta complectitur: ubi salium bituminum lapidum gemmarum & metallorum naturae causae & usus inquiruntur* (Paris: P. Lamy, 1660). Another widely-circulated book, Libertus Fromondus's *Meteorologicorum libri sex* (1627), which we will discuss in the next chapter, holds that it will not speak of stones or frogs that one finds in the sky, because these are perfect mixtures, and meteorology is concerned only with imperfect ones, i.e., with those mixtures that have not yet driven out the form of the element to introduce their own.

We will come back to these issues in the next chapters when we will discuss Fromondus and Descartes. For now, it is important to note that the hylomorphic separation between perfect and imperfect mixtures offered a way of pedagogically organising Aristotle's material in the physics course, in an *ordo doctrinae*. The most used Jesuit manual of the seventeenth century, produced by Coimbra, is eloquent in this respect. The Conimbricenses present 'meteorology' in the following way: after Aristotle dealt with the doctrine of the generation of common elements and other corruptible substances, he finally came to look at singular mixtures. These are of two kinds: mixtures according to quality (imperfect) or mixtures according to substance (perfect). The latter, in turn, can be divided into animate and inanimate, etc.²⁴ The investigation starts from the elements, continues with the imperfect mixtures and, finally, with the perfect ones, ending with *De Anima* and the smaller biological works. The hylomorphic theory of

²⁴ *Commentarii Collegii Conimbricensis S. I. in libros Metereorum Aristotelis Stagiritae* (Lisbon, 1592; I use the Lyon: H. Cardon, 1618 edition, among the 112 known European editions of these manuals), proemium. The Coimbra authors retain the Alexandrine opinion about the placement of the books as 'not devoid of probability', but chose to stick with the more orthodox one, as *verisimilior* (without arguing).

mixtures directs the discipline as it is shaped in the sixteenth century Aristotelian literature.

Turning to the subject matter of the course, the next section will show how the other facet of hylomorphism, the theory of generation and corruption, is similarly adapted to the theory of elemental mixtures.

3.3 Substantial mutation and putrefaction

The hylomorphic thesis is directly linked with the concepts of generation and corruption of substance as *immediate* processes. The principle that a new substance is generated at the exact moment when a new substantial form is introduced, and that a substance perishes when it loses its substantial form, is axiomatic for late Aristotelian physics. Consequently, a material body's lifespan ranges from generation to corruption.²⁵ Pázmány states this view as follows: 'postquam res corrupta est, jam non est ipsa, sed aliud'.²⁶ As opposed to generation and corruption, alteration is the process that expresses the gradual

²⁵ For a discussion of generation and corruption in hylomorphic theory, see R. Pasnau, *Metaphysical Themes*, pp. 552–7; for the hylomorphic structure of substance in late Aristotelianism and the concepts of substantial vs. accidental forms, see D. Des Chene, *Physiologia*, pp. 122–67. See also Thomas, *Sum. theol.* Ia, q. 76, a. 4, co.: 'Forma autem substantialis dat esse simpliciter, et ideo per eius adventum dicitur aliquid simpliciter generari, et per eius recessum simpliciter corrumpi'. Generation *simpliciter* or substantial generation, whereby a substantial form is introduced, is to be contrasted with generation *secundum quid*, or accidental generation, which equals alteration. See also Buridan, *De Gen. et corr.*, lib. I, q. 6 in *Quaestiones super libros De generatione et corruptione Aristotelis*, ed. by M. Streijger, P.J.J.M. Bakker, and J.M.M.H. Thijssen, (Leiden, Boston: E.J. Brill, 2010), p. 69.

²⁶ *De putrefactione*, in *Opera* 3: 419. Cf. his *De Gen. et corr.* I, disp. 1, q. 1, dub. 2, *Opera* 3: 118–19: 'Est enim generatio quaedam transformatio unius compositi in aliud, qua mediante materia ex una forma ad aliam transmutatur.'

transformation of substance: it is a process of change of accidental forms, without resulting in a change of substantial form.²⁷

Late Aristotelian meteorological bodies are also submitted to this hylomorphic model of change. The distinction between substantial generation and mere alteration grounds the distinction between perfect and imperfect mixtures. Perfect mixtures (minerals, animals) arise from substantial generation, with the introduction of a new substantial form, while imperfect mixtures (clouds, hail) result from an alteration of the qualities of the elements, without introducing a new substantial form. As we have seen, it was commonly held that *Meteor.* IV works with perfect mixtures: consequently they should be treated in terms of substantial (punctual) generation and corruption.²⁸ Generation, applied to mixtures, means aggregation from the four elements under the direction of a new form. Similarly, corruption will be the resolution of the mixed body into the composing elements. Between generation and corruption, there are alterative processes. But what about more complicated ‘meteorological’ problems, such as putrefaction, one of the topics discussed in Aristotle’s *Meteor.* IV? Putrefaction is a case that challenges the hylomorphic model of immediate generation, gradual alteration and immediate corruption. It is both a gradual process, such as alteration, but it also expresses a loss of form, such as corruption. Pázmány’s exegesis to this topic of *Meteor.* IV raises this precise challenge (*De putrefactione*, in *Opera* 3: 418–38).

²⁷ See for instance Descartes explaining to Regius in letter from December 1641, in AT III 461: ‘Alteratio simplex est illa quae non mutat formam subjecti, ut calefactio in ligno; generatio vero, quae mutat formam, ut ignitio; et sane, quamvis unum alio modo non fiat quam aliud, est tamen magna differentia in modo concipiendi, ac etiam in rei veritate.’

²⁸ ‘Haec ergo . . . mixtio sub generatione substantiali continetur, atque ideo convenit illi tota ratio generationis supra explicata, quod scilicet essentialiter sit mutatio totius in totum, etc. Est enim actio productiva substantiae.’ (Pázmány, *De mixtione*, in *Opera* 3: 389).

3.3.1 Aristotle on putrefaction

The definition of putrefaction in Aristotle's *Meteor.* IV is ambiguous. Usually, the commentators reveal two senses in which Aristotle speaks of putrefaction: in one sense he is taken to speak of putrefaction as a case of corruption, in another sense he is taken to equal putrefaction with alteration.

The first sense is read into Aristotle's definition of putrefaction as the opposite of (substantial) generation in natural things:

[Text A, 379a 3–5] But the strictest general opposite of unqualified becoming [= *generatio*] is putrefaction. All natural destruction is on the way to it, as are, for instance, growing old or growing dry. Putrescence is the end of all these things, that is of all natural objects, except such as are destroyed by violence.²⁹

However, immediately after Text A, where Aristotle defines putrefaction as a case of corruption, he talks about a 'special sense' of decay as a partial destruction, which will be read by the commentary tradition as a case of alteration:

²⁹ Trans. E.W. Webster in *The Complete Works of Aristotle. The Revised Oxford Translation*, ed. by J. Barnes, 2 vols. (Princeton, 1984).

[Text B, 379a 13–15] In a special sense the word putrefaction is applied to partial destruction, when a thing's nature is perverted.³⁰

I will call Aristotle's two senses of putrefaction meaning A (=corruption) and meaning B (=alteration).

This textual equivocation will generate a peculiar career in the commentary. Outside the literature on *Meteor.* IV, putrefaction is usually discussed in the medical literature, together with its counterpart, concoction. Putrefaction is the most important cause of disease, the origin of fevers or the cause of plagues (through the putrefaction of the air). Concoction or digestion is the process through which putrefaction is countered, by generating new matter. Commentaries to Galen's *Techne iatrike* (known in medicine as *Ars medica*, *Ars parva*, *Microtegni* or *Tegni*) invariably refer to Aristotle's discussion of putrefaction from *Meteor.* IV, with a therapeutic scope: if putrefaction is caused by the victory of the passive qualities over the active ones, as per Aristotle's teaching (*Meteor.* IV 379a 1–5), then one should be able to influence their mix for the betterment of the affected body.³¹ Consequently, Galenists take putrefaction to have a certain latitude: a gradual invasive process, it can be healed up to a point, as long as it has not reached a degree of corruption that affects the entire substance. However, the treatment of putrefaction in this medical literature is at odds with Aristotle's meaning A, of putrefaction as a case of corruption. Confronting this tradition, Pázmány puts the question in direct ontological terms: is putrefaction a case of substantial corruption, as Aristotle says, or is it a case of alteration? What is it *formaliter*, asks Pázmány?

He acknowledges 'big difficulties in this question' (*Opera* 3: 418). The commentators he refers to are Alexander and Vicomercato, who according to him

³⁰ Ibid.

³¹ See P.-G. Ottosson, *Scholastic medicine and philosophy: a study of Commentaries on Galen's Tegni (ca. 1300–1450)* (Naples: Bibliopolis, 1984). For putrefaction in Galen, see R.E. Siegel, *Galen's System of Physiology and Medicine* (Basel: Karger, 1968), pp. 169–70.

ignore the issue (and indeed they do); Pomponazzi, who rests undecided on the matter in spite of treating it extensively in a number of his *dubitationes*; Petrus Turrisanus, the commentator on Galen, and another Paduan, Gaetano di Thiene, both of whom take putrefaction to be a case of alteration.³² Since the problem is not extensively discussed in the commentary literature in these ontological terms (among his sources, Gaetano da Thiene is really the only one who takes up the issue), Pázmány will have to come up with his own solution.

There are three types of problems that Pázmány has with Aristotle's account (*Opera* 3: 418): (1) it is textually contradictory ('Aristoteles videtur sibi in hac re repugnare,'); (2) it goes against the view of the medical tradition ('Secunda difficultas. Aristoteles videtur Galeno et medicis adversari'); and (3) there are conceptual difficulties in formally defining putrefaction the way that Aristotle wants to do ('rationes sunt contra Aristotelem'). He expands on (1) and (3).

(1) *Aristoteles videtur sibi in hac re repugnare.*

One textual contradiction is in the temporal placement of putrefaction in the sequence of substantial mutation. Aristotle explicitly says (1) that corruption

³² Vicomercato, although he has an extensive commentary on putrefaction, does not address the ontological matter. See Pietro Pomponazzi, *Dubitationes in quantum Meteorologicorum Aristotelis librum* (Venice: F. de Franciscis, 1563), 18 sq; Pietro Torrigiano de' Torrigiani (known as Drusianus/Turisanus *et al.*, ca. 1270–ca. 1350), *Plus quam commentum in parvam Galeni artem . . . cum duplici textus interpretatione, antiqua scilicet & Leonicensi, & eiusdem libello de Hypostasi . . . Martianus Rota . . . auxit & emendavit*, (Venice: apud Juntus, 1557), lib. III, comm. 5, p. 102–103 ('utrum putrefactio sit alteration secundum totam substantiam'). Gaetano di Thiene (1387–ca. 1465), *In quatuor Aristotelis metheororum libros expositio* (Rouen, 1476, Venice, 1491 et al.), lib. IV, tr. I, c. 2. These authors recognize and discuss the 'aequivocatio' in Aristotle's pronunciation on putrefaction as both a case of corruption and a path to corruption. (Strangely enough, for Pomponazzi, Pázmány sends the reader to 'dub. 23, 25, 26 etc.' omitting precisely the Dub. 24, p. 18–19, where the issue is actually taken up.) Commentators who do not take into account the Galenic understanding of putrefaction as alteration normally do not have this problem and take it to be a case of corruption.

precedes putrefaction, as a path towards it, while he explains next (2) that putrefaction occurs through the loss of natural heat; but (3) the loss of natural heat, as in animals, is a case of corruption of substance, therefore (4) corruption comes *after* putrefaction. Claim (4) contradicts (1).³³ Another textual contradiction: when Aristotle claims that putrefaction is the maximum contrary to generation, he makes it *formaliter* a case of corruption; but this contradicts Aristotle's second definition of putrefaction as a *path* towards corruption, which would make putrefaction a path towards itself.³⁴

(3) *Rationes sunt contra Aristotelem.*

(1) There is a logical contradiction in the definitions of the concepts: putrefaction cannot be posterior to corruption because corruption is supposed to be the ultimate state of a body as *that* body. There is strictly speaking nothing post-corruption. If putrefaction occurs after the corruption of the body, it cannot be assigned to the same body, but to another body (say, the corpse generated by the corruption). A counterargument would be that Aristotle never says that putrefaction has to occur *in the same body* as corruption. But if we apply putrefaction and corruption to different bodies, there is no sense in which we can decide whether putrefaction leads to corruption, as per Aristotle's text, or vice versa, since there would be no causal connection between the body prior to corruption and the body generated after corruption.³⁵

³³ 'Textu enim 3. hic docet corruptionem praecedere putrefactionem, et corruptionem viam esse ad putrefactionem. At inferius text. 6 vult putrefactionem esse deperditionem naturalis caloris, ex quo sequitur putrefactionem praecedere corruptionem. Prius enim debet naturalis calor deperdi quam animal moriatur.' (*Opera* 3: 418).

³⁴ 'In hoc text. 3. dicit putrefactionem esse maxime contrariam generationi simpliciter. Ergo putrefactio est formaliter corruptio. . . . At in hoc text. 3. dicit corruptionem esse viam ad putrefactionem. Ergo idem via ad se.' (*Opera* 3: 418–19).

³⁵ 'Quia dicit putrefactionem corruptione posteriorem esse, quod fieri non potest quia corruptio est ultimum in quod res abit; ergo nihil est post corruptionem. . . . Postquam res corrupta est, jam non est ipsa, sed aliud: ergo si post corruptionem sit putrefactio non eadem

(2) The second conceptual contradiction that Pázmány reveals is more interesting for us, because it expresses the tension between hylomorphism and the theory of elements: *putrefaction of mixtures is both a gradual process and an immediate one*.³⁶ Take the case of a complex mixture (blood, wine, or a cadaver). The decomposition of a complex mixture can be seen as both an *infinite* process and a *finite* process. As an *infinite* process, the corruption of one mixture leads to the generation of another, down to infinity: e.g., from a living animal to a corpse and then to earth, from earth to plants, etc. This type of process is submitted to Aristotle's axiom of unceasing change, that the generation of one thing is the corruption of another, and vice versa (*De Gen. et corr.*, 318a 23–5). As a *finite* process, the decomposition of a complex mixture should reach at its lowest level a certain simple mixture that is then *immediately* corrupted, i.e., it is immediately resolved into the elements. In such a case, according to Pázmány, we have a case of corruption that does not lead to any generation, and this goes against Aristotle's axiom of unceasing change.

3.3.2 Pázmány's solution

Pázmány proposes a series of refinements of the concept, in four stages.

(1) Putrefaction is 'a sort of' corruption ('Putrefactio formaliter est quaedam corruptio', *Opera* 3: 419). This definition needs to be kept as it has the advantage of explaining well a number of Aristotle's phrases from the text at hand. A putrefied thing is as far away from its substance as it can get ('cum dicimus aliquid esse putridum, maxime remotum esse a sua substantia', *Opera* 3: 419–

res putrescet et corrumpetur . . . Dices: non dicit Aristoteles putrescere esse posteriorem corruptione ejusdem rei. Sed corruptionem unius esse ante putrefactionem alterius. . . . Nam cum text. 27. 1. De generat. dicatur corruptio unius esse generatio alterius.' (*Opera* 3: 419).

³⁶ 'Putrefactio est ipsa formalis corruptio quorundam mixtorum, ut vini, sanguinis, cadaveris, etc. Praeterea vel erit infinitus processus vel deveniendum tandem est ad aliquod mixtum quod immediate putrescat.' (*Opera* 3: 419).

20). As a corollary, this does a good job accommodating Aristotle's treatment of putrefaction as the loss of heat from *Meteor.* IV 379a 17–26 ('putrefactio est corruptio caliditatis propriae et secundum naturam', *Opera* 3: 429): in the case of animals, the loss of heat indeed results in a corruption of substance.

(2) Putrefaction, Pázmány adds, is not just corruption: it also 'implies' (*connotat*) the alteration prior to corruption:

I understand putrefaction as a certain substantial mutation, but one that implies (*connotat*) its precedent alteration, so that although formally it is said to be a corruption, it also signifies (*connotat*) an alteration.³⁷

This modification should explain that putrefaction happens in time, which one cannot say about corruption ('at in tempore non fit corruptio sed alteratio precedens', *Opera* 3: 420). The key here is the verb *connotare*: even though *formally* putrefaction is a case of corruption, it also 'signifies with it' (*connotat*) the alteration through which the corruption actually takes place.

This definition, according to Pázmány, should solve the formal concept. Up to here, Pázmány's advancement is to say that the concepts of corruption and alteration need to be joined together in a single concept in order to account for the physical phenomenon. This amounts to little more than a change of terms, but it responds to that general demand of Aristotelianism to solve problems both *in voce* and *in re*. *In re* however, he still has the problem of deciding between the anteriority or posteriority of putrefaction with respect to corruption.

(3) Experiential evidence indicates that there must be a certain way in which we can say that putrefaction follows corruption. This appears to be so in animals and plants, which first die and then putrefy (*Opera* 3: 420). But, as a

³⁷ 'Per putrefactionem intelligimus aliquam mutationem substantialem, sed ut connotat alterationem praecedentem, ita tamen ut formaliter dicat corruptionem, connotet alterationem.' (*Opera* 3: 420).

counter-example, meat putrefies before being resolved into the elements. *In re*, putrefaction both precedes and follows corruption.

To solve this, Pázmány decomposes the ontology of mixtures based on generation and corruption to allow an understanding of *successive substantial mutation of mixtures*. This will modify the understanding of a body as delimited by absolute corruption and absolute generation (*postquam res corrupta est, jam non est ipsa, sed aliud*).

(4) Putrefaction is not just *any* corruption or just *any* alteration. It is the ultimate corruption of a thing, which ‘connotes’ (signifies simultaneously) the alteration that takes place just before this last corruption.³⁸ In order to understand this, Pázmány says, we must take substantial mutation as composed of a series of sequential corruptions and generations, parts getting corrupted and generating other parts out of that corruption until forming the final substance. If this is so, in the series of generations and corruptions that make up a mixed body through successive states, one can point to the ultimate corruption of a thing as its putrefied state, together with the alteration that leads to it:

In simple speech, one thing has only one corruption, as one is the essence that gets lost through corruption; yet considering the multitude of things, there is an infinity of corruptions, since the generation of one thing is the corruption of another. But according to common opinion and sense and even according to reason, in another sense one thing has many generations and corruptions, and one can distinguish the last generation and the last corruption.³⁹

³⁸ ‘Putrefactio non est quaecunque corruptio sed ultima, nec connotat quaecunque alterationem sed quae praecedit ultimam corruptionem.’ (*Opera* 3: 421).

³⁹ ‘Simpliciter loquendo unius rei una est corruptio, sicut una est essentia quae per corruptionem perditur, plurium tamen rerum infinitae sunt corruptiones, cum unius generatio sit corruptio alterius. Secundum tamen sensum et communem hominum

The example is taken from the case of the most perfect mixtures like animals, which, because they are so distant from the elements, cannot travel across natures directly, but only through a series of successive median states. These perfect mixtures are produced from the elements out of many subordinated generations: juices are generated out of the elements, out of the juices, herbs, out of the eaten herbs, the chyle, out of the chyle, the blood, out of the blood, sperm, out of sperm the embryo and out of the embryo, the animal. If this is so, one can distinguish the first generation, that of the transmutation of the elements in the juice, and the last generation, the generation of the animal. In the same sense, in a resolution from the perfect mixture down to the elements, nature does not traverse one mutation, but many mutations. Man is corrupted into a cadaver (the first corruption), and the cadaver is corrupted further into the elements (the last corruption).⁴⁰

Although Pázmány does not provide any authority for this view but presents it as founded in ‘common opinion, sense, and reason’, an immediate source in hylomorphic theory is Saint Thomas’s account of the succession of forms.⁴¹ According to Thomas, when a form is very distant from elemental matter, like in animals, there is a graduation towards the ultimate form that passes through a series of intermediary forms. Thomas exposes this view in a series of texts, and the reader can refer to *Sum. theol.* I^a q. 118 a. 2 ad 2, *Contra Gent.*, lib. 2 c. 89 n. 11, *De potentia*, q. 3 a. 9 ad 9. Although we do not have a Thomist exposition on *Meteor.* IV, one can assume a compatibility between Pázmány’s solution and Thomas’s views on complex generation.

opinionem et rationem etiam, aliquo modo unius rei sunt plures generationes et corruptiones, et reperitur prima et ultima generatio et corruptio.’ (*Opera* 3: 421).

⁴⁰ ‘Eodem modo a mixto perfecto ad elementa non transit natura unica mutatione sed pluribus, ita homo corrumpitur in cadavere, cadaver resolvitur in elementa, illa ergo corruptio per quam perditur mixtum perfectum dicitur prima corruptio, per quam resolvitur in elementa dicitur ultima.’ (*Opera* 3: 421).

⁴¹ Pázmány knew his Thomas well: his lectures on the *Sum. theol.* form three volumes of the Latin *Opera* (4, 5 and 6). However, he only lectured on the second and third part.

Thomas's account is motivated by the theory of species: as long as the species is not affected, there can be any number of successive generations and corruptions. Nevertheless, Thomas, as far as I know, always gives this view in the context of explaining the generation of animals.⁴² A compatible (though simpler) view with respect to putrefaction proper can be found in Albertus Magnus' commentary (*Lib. IV Meteor.*, tract. I, cap. III, in *Opera omnia*, ed. A. Borgnet, 4: 710b–11b). For Albert, there are two distinct types/senses of generation: the universal generation of substance, the contrary of which is the destruction of substance (*corruptio*), and generation as applied to mixtures ('generatio mixti naturalis secundum quod mixtum est'), the contrary of which is putrefaction. Pázmány does not arrive at an original conception on putrefaction, however interesting his argumentation may look. While there is not a lot of discussion on this in the early modern period outside of the medical literature, it is a doctrine that one can find in other Jesuit commentaries on *Meteor. IV*. One example can be Sylvestro Mauro's Aristotelian manual of 1668, which presents Albert's view on the distinction between *absolute* generation and corruption and *natural* generation and corruption, where natural corruption equals putrefaction.⁴³

Pázmány does provide a commendable commentary to this particular Aristotelian text, with respect to what can be found elsewhere. His remaining discussion on putrefaction and concoction will be devoted to presenting advantages of this theory of material substance over the difficulties encountered in the commentary tradition to *Meteor. IV*. Aristotle should not have meant that

⁴² It seems that the philosophical origin of the theory of complex generation is indeed the explanation of the generation of animals; one author, Simon de Faversham, reported by R. Zavalloni, *Richard de Mediavilla et la controverse sur la pluralité des formes* (Louvain: Éditions de l'Institut supérieur de philosophie, 1951), p. 255, n. 31, contrasts the 'simple generation' of minerals and the successive generation of man.

⁴³ Sylvestro Mauro, *Aristotelis Opera quae extant omnia brevi paraphrasi* (Rome: typis A. Bernabo, 1668), vol. 3, pp. 654–6. A similar view in Agostino Nifo's *Subtilissima Commentaria in libros meteorologicorum & in librum de Mistis, sive Quartum Meteororum* (Venice: H. Scotus, 1560), p. 537: corruption applies to both mixtures and simple bodies, while putrefaction applies only to mixtures.

putrefaction is posterior to all corruption, but only to the series of corruptions that precede the last one. Similarly, he must have spoken of corruption as a ‘path’ to putrefaction referring to this series of corruptions, minus the last one (*Opera* 3: 423). And crucially, Pázmány’s solution of successive mixtures also solves the contradiction with the Galenic view of putrefaction. Because the mixed body is composed of parts, some of its parts can be corrupted and putrefy before the putrefaction of the whole, and therefore are susceptible to healing. The alteration alone minus the ultimate state of corruption is the putrefaction that the Galenists can speak of and fix through expurgation (*Opera* 3: 424).

Conclusion

I have argued, with respect to Maier’s thesis on the irreducible tension between hylomorphism and the theory of elements, that there is a coherent view of their compatibility at work in the sixteenth-century commentary to *Meteorologica*. Pázmány’s disputations offer a number of elements for this argument. On the one hand, there is an evident pressure to use the thesis of hylomorphic composition in drawing up solutions to textual problems in Aristotle: from the definition of meteorology as a science of mixtures and the place of Book IV in the corpus to a more flexible reading of Aristotle’s concepts of generation and corruption. This is one case of organic accommodation between two matter theories that need not necessarily be viewed as rivals.

The tendency of the Aristotelian exegesis to impose a certain coherence over the material from Aristotle’s *Meteorologica* books is commonplace in the sixteenth century. But innovation is not Pázmány’s goal: defence is. Pázmány’s view on the placement of *Meteor.* IV, though common, did not go unchallenged, as seen from the reported opinions of Alexander and Vicomercato. The challenge led the Jesuit university course to argue more forcefully for the coherence of the *Meteorologica* corpus, applying the well-established theological routine of enforcing orthodoxy in the face of heterodox challenges. In doing so, the path

chosen was hylomorphism: mixtures are divided into perfect and imperfect according to their hylomorphic constitution, whether they receive their own form or not. The Aristotelian corpus will be organized accordingly.

Pázmány's discussion over the proper order of Aristotle's books should count against a certain pervasive view in the literature that opposes the heterogeneity of the Aristotelian university course, dictated by the fragmentation of Aristotle's text, to a much tighter epistemological articulation of the 'moderns.'⁴⁴ This view may hold for the commentaries of the masters of the Middle Ages, and it certainly can be argued for on a case-by-case basis. But it seems to me that the effort of the late sixteenth century, and especially that of an organization centred on pedagogical excellency such as the S. J., goes precisely towards reaching a sound epistemological basis for its teaching. Given the fragmentary nature of Aristotle's corpus and the monolithic reading to which the Latin commentators tended, this effort was accomplished, within Aristotelianism, through an effort of synchronic interpretation whose unquestioned core was the hylomorphic thesis.

The imposition of the hylomorphic thesis goes beyond the arrangement of the corpus according to its ontology, into the explanatory accounts themselves. In his treatment, Pázmány takes the theory of the succession of forms one step further from Thomas to apply it to all mixtures, whether animated or not. Given that putrefaction is a process that affects all mixed bodies, a process that stops only at the level of the elements, and given that this process rests on the theory of intermediary forms, hylomorphic successiveness characterizes *all* mixtures. The progression of his argument shows how he is pressured to do so by the elemental theory of mixtures: one needs to account for the aggregation of the elements and

⁴⁴ As an example of this view, Ugo Baldini writes in his excellent study of Jesuit physics that 'dato che le opere aristoteliche non hanno un andamento strettamente concatenato, la serie [delle quaestiones] non corrispondeva a un ordine logico, ma solo a uno testuale. L'assenza del primo è forse la differenza più rilevante tra un corso «fisico» scolastico e uno moderno', etc. U. Baldini, *Saggi sulla cultura della Compagnia di Gesù (secoli XVI–XVIII)* (Padua: CLEUP 2000), p. 243.

the resolution into the elements. In this analysis, elemental theory and hylomorphism are both used.

Was it a search for compatibility between the two theories? One can look at the rigidity of the Aristotelian hylomorphic framework, expressed in the concepts of *immediate* generation and *immediate* corruption, and see in the view of the succession of forms as forged precisely to accommodate the theory of mixtures. This accommodation was already a common ground for the late medieval understanding of material substance. Aristotle's hylomorphism was not exactly the framework in which the sixteenth century read Aristotle's natural philosophy; it was a version of it forged by earlier medieval masters.

It would be too much to claim, by tracing this filiation, a direct influence of Thomas on Pázmány in this precise point, for the simple reason that Thomas does not have a commentary on the topic. But Pázmány does have Thomist views on physical matters. He adheres to typical Thomist doctrines, such as the potency of matter, to the idea of individuation through matter or the doctrine of a single substantial form in individuals. It is known that the first generations of Jesuits leaned towards Thomism, as opposed to authors from the later half of the seventeenth century, and that this leaning was especially strong during Claudio Acquaviva's office as Superior General (1581–1615), which covers the date of our text. That being said, the view of the sequential generation of parts in the animal was widespread, it was fairly well supported by common experience, and it was taken to rest on Aristotle's axiom of unceasing change, that the generation of one thing is the corruption of another, and vice versa.

I do take Thomas as the prominent reference for this position because I understand the view of the succession of forms to be linked with unitarianism. The 'Thomistae' are the prime defenders of unitarianism (i.e., the position that an individual substance has one single substantial form) against the pluralists (i.e., tenants of the view that multiple forms coexist in the same individual).⁴⁵

⁴⁵ For a good overview of the matter, extensively discussed in medieval scholarship, see F. Suárez, DM XV, sec. 10. Cf. also Pázmány's discussion in *Physica*, disp. III, q. 3, in *Opera* 2: 139–65, where he argues against the plurality of forms.

Aristotle's axiom of unceasing change, to which the view of the succession of forms appeals, entails a causal order that precludes multiple forms of integral parts to be present *simultaneously* in the final mixture.⁴⁶ The sequential order of several generations and several corruptions of parts expresses the diachronic evolution of mixtures. Thus the succession of forms in mixtures counts against the view where the forms of parts are generated *and kept as generated* in the mixed body. Pázmány's text insists on the linearity of the sequence: *prima generatio*, *ultima corruptio*, and all the in between.

To help put the status of this matter into perspective, a look at the situation later in the seventeenth century may help. In 1646, the Jesuit Niccolò Cabeo published four volumes on *Meteorologica*, when corpuscularianism was already the philosophy of the day. He distinguished there between the 'metaphysical principles' of matter, form and privation, as abstracted by the intellect from one singular entity, and the 'physical principles' of the elements as ingredients. Cabeo, attached to corpuscularianism, does not see any incompatibility in a double determination of matter; there are just two different levels of the analysis.⁴⁷ The split between a 'metaphysical' doctrine of hylomorphism and a 'physical' doctrine of the elements is not there yet in Pázmány; they coexist and work together in exegetical practice.

⁴⁶ Cf. a passage from Buridan, *De Gen.*, I, 7 (ed. Streijger et al., op. cit., p. 77), which makes explicit the link between unitarianism and Aristotle's axiom: 'Sed si poneretur quod in nullo eodem supposito sunt simul plures formae substantiales, tunc universaliter esset dicendum quod omnem generationem unius substantialem concomitatur corruptio substantialis alterius.'

⁴⁷ *Philosophia experimentalis, sive In quatuor libros meteorologicorum*, 4 vols. (Rome, 1686 [first edition 1646]), vol. 4, p. 4–5. On Cabeo, see C. Martin, *Renaissance Meteorology*, ch. 5.

Note on the dating of Pázmány's disputations over *Meteor.*

IV

Significantly, Pázmány's own disputations over *Meteor.* IV are separated from the rest of his lectures on *Meteorologica* in the text that we have. They are placed in the *Opera Omnia* edition and in the manuscript between the lectures on the *De Gen. et corr.* and those on *Meteor.* I–III. The arrangement reflects the alexandrine position of attaching *Meteor.* IV to *De Gen. et corr.* This is confusing, because Pázmány himself argues against the separation of the books, as we have seen in section I. It seems that he is not following his own preaching.

The editor of the *Physics* in the nineteenth-century *Opera omnia*, Stephan Bognár, writes in his preface: 'Item quartum librum Meteorom, qui nihil de meteoris proprie dictis continet, et plerisque ad libros De generatione spectare videtur, statim post libros De generatione spectare, ante tres priores libros meteorologicos explicat' (*Opera* 3: vi). This pronunciation goes against Pázmány's argumentation in the text of *Meteor.* IV, but reflects the status of the manuscript. Paul Richard Blum, after following the manuscript, concludes that '[The treatise on *Meteor.* I–III] follows the previous lectures [*De mixtione*, commenting on *De Gen. et corr.*, I, 10 and the two disputations on *Meteor.* IV] both in terms of its content and chronologically, so that it could have started in December 1599; on the other hand, however, Pázmány seems to have lectured on meteorology already in the winter of 1598/99. We have no further information that could shed light on this question.'⁴⁸ Ironically, the exegesis of Pázmány today faces the same problem Pázmány's exegesis of Aristotle had: where to place *Meteor.* IV?

I will hold that the disputations on *Meteor.* I–III must have been held by Pázmány *before* those on *Meteor.* IV.

⁴⁸ P.R. Blum, 'The Cardinal's Philosophy', p. 55.

The edition of the *Physics* in the *Opera omnia* is based on an autograph manuscript held by the Budapest University Library, on which Pázmány wrote diligently the dates when he held the lectures.⁴⁹ The manuscript of *Disputatio de mixtione* (covering *De Gen.*, I, 10) is dated 4 November 1599; the two disputations on *Meteor.* IV, titled *De putrefactione* and *De concoctione*, undated, follow *De mixtione* in the manuscript. They are written on the same paper with *De mixtione* and actually continue the text from recto to verso, so there is no doubt that the disputations on *Meteor.* IV are meant to follow directly. The manuscript of the following disputations, titled *De rebus meteorologicis Disputationes* and covering material from *Meteor.* I–III, is dated by Pázmány 18 November 1598/11 December 1598. It is bound on separate sheets in the codex, so it was written separately.⁵⁰

Thus the proper sequence is this: Pázmány lectured on *Meteor.* I–III in 1598–1599 (*De rebus meteorologicis Disputationes*) and returned in autumn 1599 to lecture on *De Gen.* I, 10 (*De mixtione*) and on *Meteor.* IV (*De putrefactione* and *De concoctione*). This is consistent with practices at other Jesuit schools, where *Meteorologica* is taught as an interlude between lectures on the first and on the second book of *De Gen.*; ⁵¹ it also shows the variation that *Meteor.* IV itself is split

⁴⁹ Budapest, Egyetemi Könyvtár (University Library of Eötvös Loránd University), ms. cod. F 6. There are two manuscripts at this shelf mark, of which one is the autograph. This non-autograph ms. is not very helpful because it contains only the disputations on *Physics* and *De Gen.*

⁵⁰ For *De mixtione* (including *Meteor.* IV), the date is ‘In scholis coepi 4 Novemb. 1599 quo die post vacationem studiorum’. For *De rebus meteorologicis* (*Meteor.* I–III), the date is ‘18. Novemb. 1598 Graecii in scholis coepi 11 Decemb. 1598 cum propter pestem in scholis pergere in physica non possem’. These dates are also reported by P.R. Blum, op. cit., pp. 54–5. Blum clarifies the reference to the plague: it appears that Graz was closed in the winter of 1598/1599 because of an outbreak.

⁵¹ These are the years of the elaboration of the Jesuit *ratio studiorum*. In the 1599 version, *Meteorologica* is placed after *De Coelo* and before the second book of the *De Gen. et corr.*, which got separated from the first by one year. *Monumenta paedagogica Societatis Iesu*, ed. by L. Lukács, 7 vols. (Rome: Institutum Historicum Societatis Iesu, 1974–1992), vol. 5, p. 355.

from the rest of the books by one year. A text from Pázmány's *proemium* to *Meteor.* I–III, where he announces the lectures on *Meteor.* IV, confirms this dating.⁵² Consequently, Pázmány's entire discussion on the subject of *Meteor.* IV, meant to resist the alexandrine thesis and to keep Book IV in place *after* I–III, was followed in class.

This philological element confirms the epistemic connection between the treatment of mixtures from *De Gen. et corr.* and the subject matter of *Meteor.* IV.

⁵² 'Tribus disputationibus complectemur ea quae Aristoteles tribus prioribus libris tradit [...] nam de mixtis perfectis inanimatis, metallis scilicet lapidibus, etc., et de putrefactione, concoctione de quibus Aristoteles 4. *Meteor.*, *alibi commodius agemus*'. (*Opera* 3: 455, my emphasis).

4 Libertus Fromondus and seventeenth-century Aristotelian meteorology

We have seen in the previous chapter that the Aristotelian teaching course on meteorology depended on the broader ontological picture of the physical substance and on the theory of mixtures. The most visible consequence of this fact was the displacement of the fourth book of Aristotle's *Meteorologica* and the restriction of meteorological treatises to the first three books, dealing with imperfect mixtures. This chapter looks at Libertus Fromondus's meteorology book, a state-of-the-art Aristotelian treatise of the seventeenth century, and tries to capture a picture of the field from the point of view of an Aristotelian scientist whose preoccupations go beyond the pedagogical concern for the coherence of Aristotle. Fromondus, while inheriting the delimitation of the field established in the sixteenth century, uses Aristotelianism as a framework for genuine scientific research, and not as an exegetical exercise.

4.1 An Aristotelian man of science

Libertus Fromondus (1587–1653), professor at the University of Leuven with a long and brilliant career in both arts and theology, is remembered not only for his edition and promotion of Cornelius Jansenius's works in the 1640's, but also

for his substantial scientific production, much of which is concerned with, loosely, what he calls ‘celestial philosophy’.

Fromondus was born in Haccourt (Oupeye), in the province of Liège, in the middle of the Counter-reformation.¹ He studied at a Jesuit college in either Liège or Maastricht before graduating in philosophy at the Collège du Faucon in Leuven (1606). After teaching philosophy at the Abbey of Saint Michael in Antwerp (*O. Praem*) for three years, he moved to the Collège du Faucon, where he taught rhetoric (1609–1614) and philosophy (1614–1628), developed strong language capabilities (Greek and Hebrew), produced a number of scientific works, and pursued his theological degree. In the 1620’s, he established close ties with Cornelius Jansenius, whom he had already encountered during his college years at the Collège du Faucon, a relationship that will heavily mark his career, theological engagement and legacy. In the late 1620’s, the two men shared a house dubbed ‘La nouvelle Sorbonne’, where they dedicated themselves to the study of the Hebrew and Greek Bible and of the Church Fathers, particularly Augustine. Fromondus, who had entered the clergy at an unknown date, became doctor of theology in 1628 and took up the charge of the ordinary course of theology in 1631 from Jansenius, who had been promoted Regius Professor of divinity (scripture

¹ For Fromondus’s biography, see L. Ceyssens, ‘Le janséniste Libert Froidmont (1587–1653)’, *Bulletin de la Société d’Art et d’Histoire du Diocèse de Liège* 43 (1963): pp. 1–46 (republished in several other places), on which I mainly draw my information. *Libert Froidmont et les résistances aux révolutions scientifiques*, ed. by A.-C. Bernès (Haccourt: Association des vieilles familles de Haccourt, 1988), is a collection of essays devoted to him. See also: A. Favaro, ‘Gli oppositori di Galileo. II Liberto Froidmont’, *Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti* 41 (1893): pp. 731–45; H. Demaret, *Notice Historique sur Libert Froidmont de Haccourt* (Liège: Ecole professionnelle Saint-Jean-Berchmans, 1925); J. Forget, ‘Libert Froidmont’, in *Dictionnaire de théologie catholique*, vol. 6, coll. 925–9; A. Le Roy, ‘Libert Froidmont’, in *Biographie nationale de Belgique*, vol. 7, coll. 312–17; A. Roets, ‘Libertus Fromondus en het kerkelijk gezag’, *Sacris Erudiri* 2 (1949): pp. 335–6; P. Delsaerdt, ‘De bibliotheek van Libertus Fromondus (1587–1653)’, *Jaarboek voor Nederlandse boekgeschiedenis* 5 (1998): pp. 27–44. A conference on ‘The Life and Career of Libertus Fromondus’ was held at the Catholic University of Leuven in October 2008, the proceedings of which are yet to appear.

interpretation). In parallel with this light university charge, he lectured at the Premonstratensians at the Park Abbey (Heverlee, south of Leuven), became president of the Craenendonck College and dean of the Collegiate Saint Pieter, while continuing to publish significant scientific works. In the aftermath of the Siege of Leuven (summer of 1635), he prepared a *historiola* of it, but withdrew it from publication. After Jansenius was appointed Bishop of Ypres, Fromondus took up his Regius chair of divinity (1637).² In 1639 he became dean of the Church of St. Pieter, the oldest and most important religious institution in Leuven, and, on that account, held temporary positions of vice-rector and rector of the University. Finally, in 1640, he was named by Ferdinand of Bavaria president of the Collège de Liège. The last decade of his life was dedicated mostly to the publication and defence of Jansenius's writings, who succumbed to the plague in 1638. *Augustinus* was published in 1640 in a rather adventurous affair, edited by Fromondus and the somewhat controversial theologian Henricus Calenus, also his former colleague from his college years. Fromondus and Calenus also started a program of publication of Jansenius's biblical lectures. Fromondus's own comments on the New Testament would supplement those left by Jansenius, to cover the entire Holy Writ.³ Out of these comments, he managed to publish only the one on the *Song of Songs* during his lifetime (*Brevis commentarius in Canticum Canticorum*, 1653); the rest, on the *Acts*, on the *Apocalypse* and on the *Epistles* were published posthumously and had their audience (*In Acta apostolorum commentarius*, 1654; *Commentarius in Apocalypsum*, 1657; *Commentarius in omnes epistolas Pauli apostoli et septem catholicas*, 1663; all at Hieronymus Nempaeus in Leuven and all of them reprinted several times). Fromondus participated actively in the polemic that his friend Jansenius had with

² See also M. van Meerbeeck, 'La déposition de Libert Froidmont au procès de nomination de Cornelius Jansenius Evêque d'Ypres (1635)', in *Libert Froidmont et les résistances aux révolutions scientifiques*, pp. 47–53 and L. Ceyssens, 'Froidmont et le premier jansénisme', in *idem*, pp. 55–66.

³ See W. François, 'Augustine and the Golden Age of Biblical scholarship in Louvain (1550–1650)' in *Shaping the Bible in the Reformation. Books, Scholars and Their Readers in the Sixteenth Century*, ed. by B. Gordon and M. McLean (Leiden: E.J. Brill, 2012), pp. 235–90.

the Dutch Calvinist Gijsbertus Voetius (*Causae desperatae Gisberti Voetii, ministry calviniani, adversus spongiam Cornelii Jansenii episcopi Yprensis crisis*, Antwerp: J. Cnobbarum, 1636 and *Sycophanta epistola ad Gisb. Voetium*, Leuven: J. Zegers, 1640) and dedicated all his efforts to the Jansenist cause. His last and one of his most important works is an ample philosophical treatise on the soul, *Philosophiae christianae de anima libri quattuor* (Leuven: H. Nempeus, 1649)—a subject that, he says, concerns the theologian as much as it concerns the philosopher. Other important works include the *Labyrinthus sive de compositione continui* (Antwerp: Plantin Press, 1631), which continues the defence of the received orthodoxy, this time against atomism, with a sum of mathematical, logical and metaphysical arguments on the traditional problem of geometrical indivisibles;⁴ and *Meteorologicorum libri sex* (Antwerp: Plantin Press, 1627), one of the most widely read meteorology books of its time.

Fromondus showed an interest in astronomy from his first publication, a collection of quodlibetal questions titled *Saturnaliae Coenae, Variatae Somnio, sive Peregrinatione Coelesti* (Leuven: P. Dormalius, 1616, reprinted by H. Nempaeus in 1665). They are the result of the *Saturnalia*, a sort of a philosophical and literary festival held at Leuven. The book's interest lies chiefly in the insertion of a fantasy on a 'celestial peregrination', where Fromondus is lifted up into the atmosphere by a Genius riding the horse Pegasus, and shown wonders of the world that mortals can only glimpse at with their telescopes. Fromondus plays here the role of the peripatetic student who is educated by the Genius in the new Astronomy, presenting him with findings that are contrary to the Aristotelian astronomical vulgate. Fromondus learns that there is no sphere of the fire, that elemental air is devoid of all qualities, that the heavens are not made up of Ptolemaic solid spheres, epicycles and eccentrics, but are filled with Tyconic ether, and discusses at some length recent discoveries such as the sunspots, the rugged surface of the moon, the phases of Venus or the satellites of Jupiter, the

⁴ On this book, see G. Vanpaemel, 'Libert Froidmont et l'atomisme', in *Libert Froidmont et les résistances*, pp. 131–43 and C.R. Palmerino, 'Fromondus's *Labyrinthus sive compositione continui*', ms., forthcoming.

vexed Copernican question, and the equally vexed question of the place of the inferno, all of this in a lively prose that reflects scientific debates of the early 1600's.⁵ Some of these ideas are further developed in his *Dissertatio de cometa anni 1618* (1619), a demonstration against the Aristotelian theory that comets are fiery exhalations. This book is occasioned by the great comet of 1618 and published together with two other treatises of his colleague Thomas Fienus, a professor of medicine at Leuven, one on comets and one on the Copernican question.⁶ Fromondus goes as far as to declare in this dissertation that the apparition of the famous comet of 1618 presages the demise of the philosophers' prince.⁷

While the *Saturnaliae Caenae* remained ambiguous about Copernicanism, Fromondus's polemic with Philip Van Lansberge, a Calvinist minister from Middleburg, and his son, Jacob, which was carried out from 1629 to 1634, engaged him in the Anti-Copernican front. Van Lansberge published in 1628 a book on the 'restituted astronomy of the motion of the sun' followed in 1629 by a considerable defence of Copernicanism in vernacular. Fromondus replied in 1631 with *Ant-Aristarchus, sive orbis-terrae immobilis* (alongside Jean-Baptiste Morin, who also attacked Van Lansberge's book, branding the famous verse of the Ecclesiast, 'terra stat in aeternum; sol oritur et occidit' on the title page of his book). Jacob Van Lansberge published a defence of his father in 1633, to which

⁵ For a report on the book, see G. Monchamp, *Galilée et la Belgique. Essai historique sur les vicissitudes du système de Copernic en Belgique* (Saint-Trond: G. Moreau-Schouberechts, 1892), pp. 35–44 and T. Van Nouhuys, *The Ages of Two-faced Janus: The Comets of 1577 and 1618 and the Decline of the Aristotelian World View in the Netherlands* (Leiden: E.J. Brill, 1998), pp. 240–5.

⁶ *De cometa anni MDCXVIII Dissertationes Thomae Fieni, in Academia Lovaniensi medicinae, et Liberti Fromondi, philosophiae professorem, in quibus tum istius motus, tum aliorum omnium essentia, effectus, et praesagiendi facultas declarantur. Eiusdem Thomae Fieni epistolica quaestio an verum sit coelum moveri et terram quiescere* (Antwerp: G. a Tongris, 1619). See R. Ariew, 'Fromondus's *Meteorology* and his *Treatise on the Comet of 1618*', ms., forthcoming.

⁷ 'Hic cometa certe Aristoteli nostro non minas solum, sed exitum tullit', p. 79.

Fromondus replied with *Vesta, sive Ant-Aristarchi Vindex*, in 1634, in which he protested vehemently against the accusations of Copernicanism brought against him on account of his *Saturnalia* book.⁸ Fromondus defended the proscription of Copernicanism issued by the Sacred Congregation in 1616 (restated in 1633). The astronomical question had turned by now into a Catholics vs. Calvinists affair, each camp using Copernicanism to discredit the other.⁹

Much of the astronomical material that preoccupies Fromondus in these years is reflected also in his *Meteorologicorum libri sex* (1627), a treatise that

⁸ P. van Lansberge, *Progymnasmatum Astronomiae restitutae liber primus de motu Solis* (Middleburg: Z. Romanus, 1628). Idem, *Bedenckingen op den dagelyckschen, ende jaerlyckschen loop van den aerdt-cloot* (Middleburg: Z. Romanus, 1629). The book was reprinted 1650 and 1666 and translated into Latin: *Commentationes in motum terrae diurnum, & annuum: et in verum adspectabilis caeli typum*, trans. Martinus Hortensius (Middleburg: Z. Romanus, 1630). There is even a French translation from 1633. On Lansberge, see C. De Waard, 'Lansbergen', in *Nieuw Nederlandsch biografisch woordenboek*, ed. by P. C. Molhuysen and P. J. Block (Leiden: Sijthoff, 1912), vol. 2, coll. 775–82. Next: L. Fromondus, *Ant-Aristarchus, sive orbis-terrae immobilis* (Antwerp: Plantin Press, 1631); J.-B. Morin, *Famosi et antiqui problematis de telluris motu vel quiete hactenus optata solutio* (Paris: apud authorem, 1631); J. Van Lansberge (filius), *Apologia pro commentationibus Philippi Lansbergii in motum Terrae diurnum et annum* (Middleburg: Z. Romanus, 1633); L. Fromondus, *Vesta, sive Ant-Aristarchi vindex, adversus Iac. Lansbergium Philippi f.[ilium] medicum middelburgensem* (Antwerp: Plantin Press, 1634). See I. Pantin, 'Libert Froidmont et Galilée: l'impossible dialogue', in *Largo Campo di Filosofare Eurosymposium Galileo 2001*, ed. by J. Montesinos and C. Solis (La Orotava: Fundación canaria Orotava de historia de la ciencia, 2001), pp. 615–35.

⁹ See A. Roets, *Libertus Fromondus, Leuven-Hoogleraar, en zijn Polemik tegen den Calvinisten*, PhD thesis (University of Leuven, 1948); R. Hooykaas, 'The Reception of Copernicanism in England and the Netherlands', in his *Selected Studies in History of Science* (Coimbra: Coimbra University Press), pp. 635–63; and T. van Nouhuys, 'Copernicanism, Jansenism and Remonstranism in the Seventeenth-Century Netherlands', in *Heterodoxy in Early Modern Science and Religion*, ed. by J. Brooke and J. Maclean (Oxford: Oxford University Press, 200), pp. 145–68. Van Nouhuys holds, against Hooykaas's thesis that Calvinists were more drawn to Copernicanism, that both parties were using Copernicanism as a weapon against each other, irrespective of scientific beliefs.

presents itself as a summa of meteorological knowledge of the time. The book offers a valuable compendium for the reader unafraid of the humanist overcoat that thickens it, literary embellishments meant to replace, according to the author, ‘the old dust of the scholastics’, and mix *utilia dulcibus*.¹⁰ Among the *utilia* of the book, Fromondus’s minute observations on Belgian winds and their classification are worthy of note.¹¹ Fromondus is probably right in claiming that it is the most ample study of the subject to date; he produced one of the first stand-alone treatises on meteorology liberated from the form of a textual commentary.¹² The closest rival of the book would be Francesco Vicomercato’s great commentary on Aristotle (1565), which we have already encountered in chapter 3, but Vimercato’s book is closer to an exercise in Aristotelian scholarship (it contains a restitution of Aristotle’s Greek text and a Latin translation, together with Vicomercato’s textual and scholarly commentary). Fromondus’s sources are encyclopaedic: the Latin authors are very present, especially Seneca, his favourite author, whom he had also edited and commented,¹³ but also literary figures such as Homer, Pliny, Tacitus, Suetonius, Apuleius, and Marc Antonius; Greek Aristotelians like Alexander, Ammonius, Theophrastus, and Themistius; contemporary sources critically used: Cardano, Scaliger, Jean Bodin, Agricola, Lydiat, Cornelius Gemma, and Paracelsus are his usual enemies; Tycho, Kepler, and Galileo are his main astronomers; medieval figures such as Alhazen, Averroes, Saint Thomas, Laurentius Coloniensis, Paul of Burgos, and Themon Judaeus; recent authors such as Valesius, Vicomercato, Cesalpino, Boccadiferro, Maurolico, Francastoro, Sennert, Snellius, Melanchton, Keckermann, Godefroy Wendelin, Christoph Rothmann, and the omnipresent Collegium Conimbricense, together with more obscure figures such as Iohannes Beverus, Joseph Acosta,

¹⁰ ‘Ad lectorem’ and the approval of the censor.

¹¹ See G. Monchamp, ‘Sur deux séries d’observations météorologiques faites à Louvain en 1614 et 1625’, *Ciel et Terre* 18 (1897), pp. 239–47.

¹² ‘Moles voluminis non oppido ampla, sed quantam tamen, quam sciam, nemo hactenus in ista materia effecit’ (‘Ad lectorem’).

¹³ Fromondus continued the Lipsius edition of Seneca’s *Opera quae extant omnia* (Antwerp: Plantin Press, 1632) and appended his *Scholia ad quaestiones naturales* to it.

Jean-Baptiste Du Hamel, and François d'Aguilon, complete this heteroclite picture, sweetened with patristic quotes, from Saint Augustine to Saint Ambrose.

The course in Leuven at the time prescribed only eight months for the whole of physics, during which the student would go through all of Aristotle natural philosophy, together with some mathematics and some astronomy, which was still based on the *Sphere* of Johannes de Sacrobosco. One wonders how much time would be left to devote to the first three books of Aristotle's *Meteorology* (the fourth was not required, for reasons we have analysed in the previous chapter).¹⁴ As a term of comparison, one can look at the natural philosophy course of Iohannes Beverus, Fromondus's predecessor in Leuven some 60 years earlier, whom he quotes several times as 'Beverus noster'. Beverus's lectures were published as taught in class: meteorology occupies some 45 pages, in which the student would get a number of definitions and explanations of Aristotle's text, with little detail.¹⁵ It does not look like things had changed by Fromondus's time, judging by the statutes of the University. The fourth book was not required in the curriculum in early-seventeenth-century Leuven, according to the *visitatio* of 1617 that the University received from the paternal authority of the Archdukes Albert and Isabelle (in concert with the spiritual presence of the papal authority, 'juncta in primis Sedis Apostolicae auctoritate').¹⁶ In this sense, through its amplitude, Fromondus's book is a scientific treatise, not a teaching manual.¹⁷ His book is

¹⁴ G. Monchamp, *Histoire du cartésianisme en Belgique* (Bruxelles: Hayez, 1886), p. 10, n. 1.

¹⁵ *Ioannis Beveri in Aristotelis Stagiritae . . . de rebus naturalibus libros brevis ac dilucidus commentarius, ex quotidianis praelectionibus D. Ioannis Beveri, ordinarii ac celeberrimi quondam in Academia Lovaniensi Philosophiae professoris* (Leuven: Bartholomaeus Gravius, 1567).

¹⁶ The text of the *visitatio*, establishing the rules of conduct for the university, promulgated at 5 September 1617, stipulates the study of the three books of Aristotle's *Meteorologica* in the Faculty of Arts and is silent on the fourth book; see article CXXXIV, in E. Reusens, *Documents relatifs à l'histoire de l'Université de Louvain (1425–1797)*, tome I, (Leuven: Ch. Peeters, 1893), pp. 568–648. On this evolution, see our chapter 4.

¹⁷ C. Meinel thinks differently: 'L'Œuvre de Froidmont prend racine dans l'enseignement et est conçue pour l'enseignement' ('Les Météores de Froidmont et les Météores de Descartes',

moderately successful in the seventeenth century, with two editions on the continent (Antwerp, 1627 and Leuven, 1646) and three editions in England (Oxford, 1639 and London, 1656 and 1670).¹⁸ Thomas Barlow, writing *A library for young scholars* in mid-century Oxford, recommends Fromondus in meteorology as ‘the best of the extant’, to which ‘you may add Gassendus, Des-Cartes, Digby, White, Bacon’s *Naturall History*, or centuries of experiments’ as complementary material.¹⁹ The book is a common reference up to the end of the eighteenth century.

The layout of the treatise is simple, akin to other meteorological books of the time: a first book on meteors in general, followed by a second book on fiery meteors, a third on comets, a fourth on winds, a fifth on watery meteors (hydrography included) and a sixth on optical meteors (the rainbow, halos, parhalias, the colors of the clouds).²⁰ What follows is a presentation of the general theory of the meteors based on the first book, to which I add some selective material from the rest of the treatise and comparative material from Beverus and from the course of the Collegium Conimbricense, trying to capture a representative picture of Aristotelian meteorology at the beginning of the

p. 120). Fromondus’s scientific works may have originated from his lectures (this is true mostly for his *De anima*), but treatises such as *Labyrinthus*, *De cometa anni 1618* or *Meteorologicorum libri sex* are not teaching manuals.

¹⁸ The Leuven edition of 1646 is augmented and corrected by Fromondus. The British editions, based on the 1627 original, add the treatises on the comets by Fienus and Fromondus published in 1619 (*De cometa anni 1618 dissertationes*), Fienus’s *Disputatio an coelum moveatur et terra quiaescat*, and a collection on the famous purple rain of Brussels of 1646, *De causis naturalibus pluviae purpureae Bruxellensis clarorum virorum iudicia*, with letters by interesting men such as the Copernican Godefroy Wendelin, Pierre Gassendi, Vopiscus Fortunatus Plempius, and Renatus Moreau, approved by Fromondus’s collaborator Henricus Calenus.

¹⁹ Ed. by A. DeJordy and H. F. Fletcher (Urbana: University of Illinois Press, 1961), p. 4.

²⁰ The Conimbricenses, for instance, go similarly through the general theory of the meteors, fiery meteors, comets, optical meteors, the rainbow, winds, watery meteors, earthquakes and subterranean fires, and add metals. See the next chapter, n. 8, on the structure of Descartes’s *Météores* compared with that of other works.

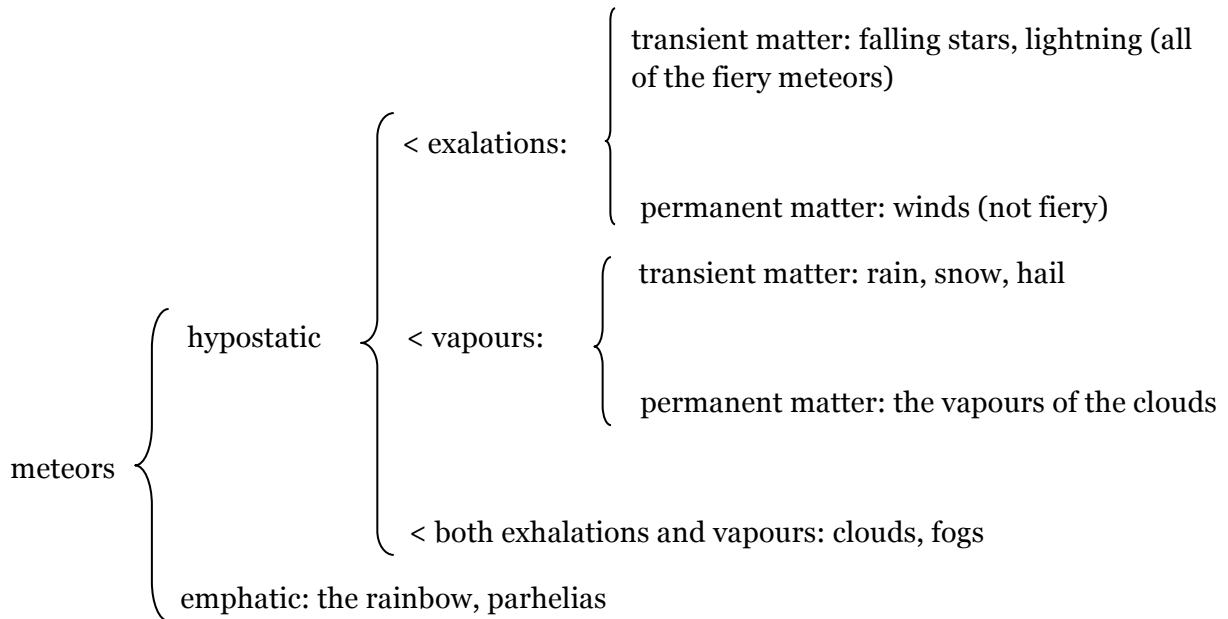
seventeenth century and extract its core doctrine. Fromondus's first book discusses the definition of the meteors, the atmosphere as the place where they arise, and their common causes.

4.2 The meteors: their definition and place

The meteors for Fromondus are defined traditionally as imperfectly mixed bodies, that is, elements corrupted by foreign qualities, unnatural to that element ('corpus imperfecte mixtum, nihil aliud est, quam Elementum infectum qualitatibus peregrinis').²¹ This ontological definition excludes from the start the material covered by Aristotle's fourth book, which deals with perfect mixtures. The meteors arise in the atmosphere (*sublime*), defined as the space between the globe composed of water and earth and the ultimate surface of the sublunary world, a part of the sky filled with the light element, air. They are physical bodies and not astronomical bodies, according to the ontological divide between the sublunary and the celestial realms. The atmosphere is divided between the three regions: the lowest, closest to the earth, is the seat of meteors such as dew or fog; the median region, comprising the clouds themselves, is the seat of storms, winds, and the like; and the supreme region, going from the clouds to the sky, is the seat of meteors such as the falling stars or sublunary comets. The meteors are then divided into hypostatic (substantial, real) and emphatic (optical phenomena: apparent, not real). The emphatic meteors are covered in the sixth book, as it is customary, in spite of the fact that they technically are not meteors. A more proper division, according to Fromondus, is based on the material origin of the meteors: they are originated either by an exhalation (terrestrial matter), a vapour (watery matter), or by a combination of the two. The vaporous meteors are 'exhaled' out of elemental water and retain its form (rain, snow, hail and the like). Among the meteors that can be traced back to an earthy exhalation, some of them

²¹ *Meteor.* I, 1, p. 1 (references are to the original 1627 edition, which was more circulated).

are fiery, having corrupted the exhalation with fire (e.g., falling stars or lightning), while some of them are closer to the original form of the exhalation, like winds or whirlwinds. Finally, some meteors combine vapours and exhalations in equal manner, such as clouds or fogs. A further division mentioned goes between meteors that have a transient matter, e.g., the fiery ones, rain, or hail, and those of a more permanent matter, e.g., winds or clouds.



This is all traditional material; but the celestial cosmology that Fromondus pictures as a framework for his meteors presents quite an original development. The Genius of the *Saturnalia* had already shown us that there is no fiery sphere, and Fromondus holds that the most probable position is indeed that the supreme region of the atmosphere goes up to the stars and the vault of the firmament, and is filled with air all the way. This picture of the atmosphere rests on the view that the heavens are fluid and not solid, as in Ptolemaic cosmology. The main arguments for the fluidity of the heavens are the motion of the celestial comets, which pass through the skies below the firmament, and the motion of the celestial air, which is stirred by the motion of the planets. For support, Fromondus sends to his colleague Thomas Fienus's 'most excellent arguments', which have demonstrated these facts sufficiently. Although Fromondus embraces the Tychonist astrological layout—the common alternative to Copernicanism at the time—he holds, against Tycho, that the ether that fills the interplanetary

space is of the same nature (*eiusdem speciei*) as the one found in the lower region. The homogeneity between earthly matter and atmospheric matter to which Fromondus subscribes requires that the ether does not have a distinct, celestial nature, as Tycho held. Indeed, according to our author, some terrestrial exhalations can reach up to the moon (one can see them colouring the sky) and bits of ether are able to descend upon the earth. If these things would be of a different nature, we would be in a position of mixing celestial and incorruptible things with earthly, mortal things, something that should not happen.²²

Fromondus goes then through material covering different aspects of the atmospheric regions: their quantity and height, according to different reports, and their elliptical or spherical figure. The supreme region is spherical, while the two other regions are elliptical, because the equator is hot, rarefying the air surrounding it, while the poles are cold. The two last chapters of the first book are dedicated to the material and efficient causes of the meteors, principles of explanation that are applicable to all meteors, which will retain us further.

4.3 The four causes of the meteors

As a part of physics, Aristotelian meteorology is a deductive science aimed at giving causal accounts of the generation of the meteors. The core of any scientific account is given by an explanation of how the four causes, acting as interdependent, ordered, principles of explanation, concur to bring about the meteor (the authoritative texts here are *An. Post.*, 71b 9–12, 94a 20 and especially *Phys.* 194b 17–20).²³ Therefore, the starting chapters of meteorological treatises,

²² ‘Halitus etiam terreni, effusissime rarefacti, supra Lunam scandent quandoque, et partes coelestis illius et Tychonici aetheris in mundum sublunarem depriment; miscebunturque mortalia divinis et incorruptilibus: quod non decet.’ (*Meteor.* I, cap. I, a. 1, p. 3).

²³ The interdependence of the four *aitia* for Aristotle is a theme treated throughout Latin Aristotelianism. See, for instance, a clear explanation of it in Saint Thomas: ‘Ad intellectum

devoted to *de meteoris in genere*, insist on explaining how the fourfold complex of Aristotelian causes (material, efficient, formal and final) applies to the science of the meteors. Fromondus makes no exception. The structure of Fromondus's accounts of the meteors will go invariably through the four converging pieces, with the pedagogical risk of making some of the accounts heavily repetitive. However, in the introductory Book I, he only treats the material and the efficient general causes of the meteors, leaving the formal and the final causes for the subsequent discussion of particular meteors.

A little context helps explain this choice. Besides the general preoccupation with applying the four causes, another concern for authors of books on meteorology is a text extracted from *Meteorologica* I, 2, 339a 20–3, where Aristotle seems to restrain his explanations in meteorology to material and efficient causes—or, at least, he seems to omit the final and formal causes from a direct involvement. The Aristotelians took this text out of its context, as they often do. Aristotle's text, however, when read in its immediate context, is not meant to be a general principle. It comes about in a discussion over the causal role of the elements in meteorology, and it simply says that the elements act only as a material cause, not as an efficient cause, which should be assigned to the celestial bodies. The phrase is:

We must treat fire and earth and the elements like them as the material causes of the events in this world (meaning by material what is subject and is affected), but must assign

autem huius literae sciendum est quod contingit definitiones diversas dari eiusdem rei, sumptas ex diversis causis. Causae autem ad invicem ordinem habent: nam ex una sumitur ratio alterius. Ex forma enim sumitur ratio materiae: talem enim oportet esse materiam, qualem forma requirit. Efficiens autem est ratio formae: quia enim agens agit sibi simile, oportet quod secundum modum agentis sit etiam modus formae, quae ex actione consequitur. Ex fine autem sumitur ratio efficientis: nam omne agens agit propter finem. Oportet ergo quod definitio, quae sumitur a fine, sit ratio et causa probativa aliarum definitionum, quae sumuntur ex aliis causis.' (*An. Post.* I, lect. 16, n. 5).

causality in the sense of the originating principle of motion to the power of the eternally moving bodies. [Meteor. I, 339a 11–339b 2, trans. E.W. Webster.]

Aristotle's pronouncement was followed assiduously, and the idea of accounting for meteors in terms of their elemental material cause coupled with the external celestial influence will survive throughout the Aristotelian tradition. But some commentators also interpreted the phrase in the stronger sense of a normative scientific principle over what type of causes are involved in meteorology: material and efficient causes only. Thus many commentators restrain the initial chapters of their books to discussions of the material and efficient cause of the meteors, either omitting or downplaying the other two types of causes, the formal and the final one. Casting aside the final and formal cause was helped by two factors. On the one hand, the final cause has always been relegated to the inscrutable domain of divine providence by Christian thinkers. On the other hand, the downplay of the formal cause was helped by the fact that Aristotle himself speaks little of forms and hylomorphic composition in the first three books of *Meteorologica*, as opposed to Book IV, where explanations in terms of qualitative change and formal causality abound.²⁴ Book IV, however, as seen in the previous chapter, came to be displaced from the first three books, or at least tended to be ignored and was not required material in the curricula. Iohannes Beverus, the aforementioned professor from the middle of the sixteenth century, spends exactly two pages on it, while Fromondus does not even mention it. In any case, complete fourfold causal accounts of the kind that Aristotelians

²⁴ It should be noted that Aristotle does mention occasionally forms in the first three books—e.g., at 357b 27–358a 3 and 359b 30–2. In the fourth book, the use of formal causality is much more present; see pp. 378b 27–379a 11: 'Next we must describe the operations of the active qualities and the forms taken by the passive, etc.' and p. 382a 28–30: 'Now there are two causes besides matter, the agent and the quality brought about, the agent being the efficient cause, the quality the formal cause.' See M. Wilson, *Structure and Method in Aristotle's Meteorologica*, ch. 4, for an account of causation in *Meteorologica*.

liked to display pedagogically found little support in the text of Aristotle's *Meteorologica*.

We can note, for instance, that the manual produced by the Jesuits of Coimbra, probably the most widespread teaching book of the century (with 112 known editions), restricts their chapter on causes to the material and efficient one, and does not even mention other types of causes.²⁵ Beverus also devotes his chapter on the 'causae impressionum' to the material and efficient cause only (the elements and the celestial bodies, respectively). He also comments on the text from *Meteor.* I, 2, quoted earlier, and excuses Aristotle from omitting formal and final because they can be judged easily from the first types of causes ('ac omissis causa formali & finali, quae ex prioribus [causis] facile diiudicari possunt').²⁶ Speaking of the four causes is just classroom routine. In fact, reports Beverus, there is one single material cause of the meteors, given by the architectural theory of matter of the two exhalations and the elements involved, just as there is one single true efficient cause of the meteors, namely the celestial bodies. The formal cause will be given by the elements, and the final cause is too closely linked with the efficient cause to merit a separate treatment.²⁷

Fromondus justifies in a similar manner his choice of restricting his introductory chapters to the material and efficient causes. The two general chapters on the material and the efficient causes are warranted by the fact that the *material cause* is *always* a vapour or an exhalation, while the remote efficient cause is *always* the heat of the sun. The *final cause* is treated with redundant expressions such as the 'metus and reverentia creatoris', and there is not much

²⁵ *Commentarii Collegii Conimbricensis Societatis Iesu . . . in libros meteorum Aristotelis Stagyrtae* (Lyon: Horatius Cardon, 1618), lib. 1, cap. 1, 'Quaenam sit materia, quae causa efficiens Meteorologicarum impressionum', pp. 1–6. References will be made to this edition.

²⁶ I. Beverus, *In Aristotelis de rebus naturalibus commentarius*, p. 244.

²⁷ 'Secundo capite tractationem meteorologicarum impressionum auspicatur a causis ad harum generationem necessariis, ac omissis causa formali & finali, quae ex prioribus facile diiudicari possunt, ait causam materiale dictarum impressionum, saltem remotam et originalem, esse elementa, & inter haec maxime terram & aquam; efficientem vero, corpora caelestia.' (Ibid., p. 244).

more one can say to make up a chapter out of this. (Needless to say, the occasional discussions one finds in contemporary literature on whether comets or other events signify the death of princes, dryness, winds or other evils, are a departure from Aristotle and very marginal.) The *formal cause*, on the contrary, is particular for each meteor and acts as an individuating principle. The proximate efficient causes, that induce the accidental form of the meteor and generate it, are also particular.²⁸ Fromondus therefore promises to develop the formal and efficient cause in the accounts of each meteor separately.²⁹

4.3.1 The material cause

Fromondus's chapter on the material cause defends the double Aristotelian *halitus*, the vapours and the exhalations, against the competing Paracelsian model featuring the chemical elements (sulphur, salt and mercury) and the production of the meteors directly from the stars, 'like a tree produces fruits.'³⁰ If one goes further down with the analysis, the two original *halitus* are ultimately resolvable in earth and water: the vapours and exhalations are the proximate matter, and the elements of water and earth are the remote matter.³¹ The two configurations, vapours and exhalations, are not essentially distinct from their predominant element. They are both mixtures of water and earth, only with different foreign qualities attached to it. Their common denominator is an original mixed

²⁸ 'Causas efficientes proximas, quae formam illam accidentariam inducunt, unde essentiae complementum et nomen habet meteorum, postea dabimus.' (*Meteor.* I, 4, p. 24).

²⁹ 'De causa formali meteororum, dicemus speciatim in pertractatione singulorum. Nunc uno verbo, et universe dico, esse aut figuram, aut localem motum, aut aliud accidens quod cum materia coit, illud accidentarium compositum, quod appellamus meteorum.' (*Meteor.* I, 3, p. 24).

³⁰ *Meteor.* I, 3, p. 19.

³¹ Cf. Collegium Conimbricense, *Meteor.* I, 1, p. 1: 'Materia remota, est potissimum terra et aqua', 'material propinqua, est vapor et exhalatio.'

exhalation raised from the heavy elements in virtue of its levity, through rarefaction ('unde halitus utrique communis nil est aliud, quam substantia levis quae e corporibus gravibus virtute caloris rarefacientis resolvitur.') Exhalations through rarefaction are common and easily confirmed by experience ('talem autem terra & aqua exhalari manifesto experimentum deprehenditur').³²

A classic ontological question that arises in discussions on vapours and exhalations is whether they differ in species or nature from the heavy elements out of which they get extracted (*Meteor.* I, 3, 2, *An vapor & exhalatio specie differant ab elementis gravibus, quibus extrahuntur*). This is a special case of the more general question on whether a meteor has a species of its own: how can it have a species, when it does not have a substantial form of its own?³³ The more radical view, usually associated with the Scotists (even though this view can hardly be traced back to Scotus himself, who never wrote on the meteors, as we have seen in chapter 1) assigns to the meteors a form of their own, distinct from the form of the element. The 'more common opinion' is that the meteors, in virtue of their retaining the form of the originating element, are not different in species, but are only separated from the elements through an accidental difference. This is precisely what differentiates them from animated perfect mixtures, says Beverus:

Contra horum corporum [i.e., animata omnia] formae tam sunt elementares, ut vix quicquam ab elementis dissideant: quod arguunt nix, glacies, pluvia, pruina, & similia, quae solum accidente ab aqua distingui videntur: tamen haec ipsa

³² *Meteor.* I, 3, p. 19.

³³ There is also the distinct but connected problem of whether meteors are distinct in species among themselves. See Themon Judaeus's discussion from his *Meteor.* I, q. 16, work discussed in chapter 1, of whether *pluvia ros* and *pruina* are different in species (we would call both these phenomena hoar frost or dew now). Themon concludes with the traditional view that they are not different in species, they just contain more or less water.

secundum meteorologicam generationem nomen elementi
amittunt, ac imperfecta mista noncupantur.³⁴

Fromondus and the Collegium Conimbricense give more elaborated and interesting arguments against the Scotist view.³⁵ The Conimbricenses assign the opinion to Philoponus and Avicenna, because they associate it with the distinction of a plurality of elemental forms in the meteors (again, Scotus did not hold this view; the plurality of forms for him affects only complex organisms). Vapours and exhalations, according to the view reported by the Conimbricenses, are distinguished from the elements as *composed* bodies from *simple* bodies. Against this distinction, the Conimbricenses send the reader back to their *De Gen. et corr.* where they had refuted the idea of a plurality of substantial forms. Since there can only be one form in one body, all bodies are simple and none of them are composed.³⁶

Fromondus starts by arguing on more experimental grounds. He assigns the view that meteors have a species of their own to ‘the Parisian school’, represented by Themon Judaeus, the productive Scotist Pierre Tartaret (d. 1522), whose opera was just gathered in print, ‘and others.’³⁷ The argument that they bring, as reported by Fromondus, is an experiential one: there seems to be no water and no earth in such levitating bodies, because of the density of water and

³⁴ Beverus, *Commentarius*, p. 242.

³⁵ Fromondus, *Meteor.* I, 3, 2, 22–3 and Collegium Conimbricense, *Meteor.* I, 1, 4–5.

³⁶ ‘Verum quam longe placitum hoc a veritate deflexerit perspicuum fiet in libr. de Gener. ubi ostendemus in eadem re haudquaquam plures formas substantiales reperiri.’ (Collegium Conimbricense, *Meteor.* I, 1, 4b).

³⁷ Petri Tartareti, Parisiensis, Scotistae Subtilissimi, *In Universam Philosophiam Opera Omnia In Tres Partes Distributa*, vol. 3 (Venice: I. Sarzina, 1621), pp. 215b–216a: ‘Alia difficultas, utrum vapor et exhalation sint corpora mixta se invice et a quolibet elemento specific distincta. Respondetur breviter, quod relictis multis opinionibus vapor et exhalatio sunt mixta imperfecta a se invice specific distincta. Dicit secundo, quod exhalatio distinguit specific a quolibet elemento’, etc. See Themon Judaeus, *Meteor.*, I, q. 9, 2, in *Questiones et decisiones physicales . . .*, op. cit., fos. CLXII–CLXIII.

earth, which is at odds with the light material constitution of the meteors ('quia incredibile est, formas terrae & aquae remanere sub tanta materiae raritate & levitate, cum naturaliter densitatem & gravitatem appetent.') Moreover, based on the reasoning that vapour is water because vapour comes out of water, one can say that the breath of an animal is the animal because it comes out of the animal ('Deinde, spiritus ex animalibus, plantis et ceteris mixtis resoluti, ab ipsis specie dissentiunt; igitur nec vapor cum aqua et exhalatio cum terra consentient').³⁸

These two divergent views over the material cause of the meteors express distinct ontological commitments; they reflect the difficulty of a scientific treatment of the meteors as bodies that do not have a substantial form of their own: how are they to be differentiated from one another? How can the meteors be individuated without a form? The 'Scotist' answer is that the meteors need to have a form of their own precisely because they cannot be individuated otherwise. 'The Scotists' quoted here are adepts of a strict formal differentiation in natural kinds. A meteorological body is distinguished from another body in virtue of its substantial form. In Scotist ontology, as we have seen in chapter 2, a difference of substantial form implies a difference of species, just as it implies that the body acquiring a new substantial form is generated and not mixed. When vapour returns to water, says Tartaret, it in fact generates water anew.³⁹ Given that meteorological matter is essentially common to all meteors (a combination of the two *halitus*), matter is not a candidate for the individuation, as in traditional Thomism (*materia signata*). Lacking both a material and a formal principle of

³⁸ Fromondus, *Meteor.* I, 3, 2, p. 22. Cf. Collegium Conimbricense, *Meteor.* I, 1, p. 4: 'alioqui halitus esset animal, quod nemo dixeret.'

³⁹ 'Et si dicatur: quod vapor est substantialiter aqua. Respondetur quod non est verum, sed bene ex ipso generatur aqua.' (Tartaret, op. cit., vol. 3, p. 216a). See Pseudo-Scotus, *Meteor.* I, q. 6, in Duns Scotus, *Opera omnia* (ed. Wadding) vol. 4, p. 23b: 'solum mutatio in accidentalibus non constituit diversitatem specifica'. On Scotus's haecceity, see *Ordinatio* II, d. III, q. 6. For the general background, see J.E. Gracia, *Introduction to the Problem of Individuation in the Early Middle Ages* (Munich: Philosophia Verlag, 1988), idem, ed., *Individuation in Scholasticism. The Later Middle Ages and the Counter-Reformation, 1150–1650* (Albany: SUNY Press, 1994), and our chapter 2.

individuation, Fromondus will resort to individuating the meteor through its foreign qualities, accidental forms. This means that there could not be a difference of species between meteors, but only a weak distinction in their accidental qualities.

Fromondus attacks the 'Parisian' opinion from two angles. If one accepts the opinion of the incorruptibility of the elements of 'some Greeks', i.e., that the elements are simple bodies in the sense that they are not composed out of matter and form, then it is more probable that vapour is nothing more than the substance of water, and the exhalation nothing more than the substance of earth, because they are the simplest bodies. In this view, vapours and exhalations are not mixtures at all; they are immediately resolvable into the originating element and the transmutable accident.

However, if one follows Aristotle and basic common sense (*et sensu fere communi*), and accepts that the hylomorphic structure applies to the elements too, then one is to say that the vapours retain the form of the originating element. The case of vapours retaining water is proven by simple experience: the vapours that adhere to the lid of a closed jar, for instance, are transformed into water when one suddenly opens the jar in a medium of hot air. This type of resolution into water can easily be shown, says Fromondus, in the common distillations of the chemists. The reduction of the earthy exhalations to elemental earth is harder to see, because these exhalations rarely reach the density of earth, so Fromondus resorts to showing at least the *possibility* of such a transformation. One cannot doubt that some bodies resolve themselves into very different materials. We see this kind of resolution happening everywhere, when bodies pass from one state of aggregation into another. Water, submitted to a certain degree of heat, effervesces, or it transforms itself into ice when submitted to cold, and thus can turn itself into a radically different materials, without any damage to its substantial form; likewise, metals are liquefied. 'I admit that the experience [of resolving exhalations into earth] is more clouded', says Fromondus. Nevertheless one can see in rainwaters that mud is formed out of the condensed vapours. Hence

‘we need not be more surprised that the earth saves its substantial form, however much Bodin would laugh in our faces.’⁴⁰

4.3.2 The formal cause

The inquiry into the material cause of the meteors leaves the weight of the scientific explanation on the formal cause, as that which specifies the meteor and puts it into a class. Fromondus’s formal accounts are reports on particular accidental forms: there is not much to be said on the substantial form, except that it is inherited from the elements. However, the formulation he gives to the general formal cause sought in meteorology is striking by the fact that it recalls the mechanical philosophy’s reliance on figure and local motion:

De causa formali meteororum, dicemus speciatim in pertractatione singulorum. Nunc uno verbo, et universe dico, esse aut figuram, aut localem motu, aut aliud accidens quod cum materiam coit, illud accidentarium compositum, quod appellamus meteorum.⁴¹

The difference between this text and the Cartesian reduction of relevant material accidents to figure and local motion is that Fromondus also admits ‘some other accident’ that is to make, together with matter, ‘the accidental composite that we call a meteor’. Both Descartes and Fromondus need to use explanations in terms of figure and local motion, but in Fromondus’s case the hylomorphic structure of physical bodies is still in place. The accidental form that specifies the meteor and gives its ultimate form can be, for instance, in the case of clouds, the

⁴⁰ *Meteor.* I, 3, 2, 22–3.

⁴¹ *Meteor.* I, 3, 2, p. 24.

condensation and concentration of the vaporous matter in the median region ('Forma [nubis] est concretio et densatio in media, aut circiter, aeris regione').⁴² Figure and motion are two frequent accidental forms responsible for the individuation of the meteors (and sometimes they are coupled with *situs*). Figure is a modification of quantity, itself an accident, through local motion. Figure, motion and *situs* are called non-essential, passive qualities, since they are not capable of arising intrinsically; ultimately, they are all reducible to local motion, which causes them. When Descartes will insist on the fact that figure is nothing more than a mode of extension, he is not at odds with the practice of Aristotelian physics, and meteors will be identified through their figure both in Descartes and Fromondus. Though Aristotelian physics took great care to guard itself from identifying figure with a complete (substantial) form in its arguments against Atomism, the idea that figure can be taken for a formal cause is frequent in meteorology. The form of the comet is the figure of a star, just as the formal cause of the halo is its circular figure for Fromondus ('[caussa] formalis, figura illa circularis, qua astrum cingit').⁴³ However, figure could not be a complete form, for it requires the elemental form to compose the meteor as a physical substance.

A straightforward account of how substantial vs. accidental forms work can be gleaned from Fromondus's treatment of the formal cause of the comets. Comets constitute a special case, because they are composed of two distinct types of bodies: celestial comets, basically on a par with planets, are not strictly speaking meteors, because they do not arise from an exhalation and they are not situated bellow the atmosphere. Sublunary comets, on the contrary, are just earthy exhalations. The substantial form of the comets unifies the class into a species, which includes sublunary as well as celestial comets. Other accidents distinguish them further:

⁴² *Meteor.* V, 5, p. 315.

⁴³ *Meteor.* VI, 2, p. 394. On the geometrical interpretation of form, see N.E. Emerton, *The Scientific Reinterpretation of Form* (Ithaca and London: Cornell University Press, 1984), especially pp. 126–53 on crystals and minerals.

Forma Cometae tam coelestis, quam sublunaris, est figura stellaris & lumen. Haec enim universim fundant similitudinem Cometae, mobilis, sive immobilis, comantis, sive calvi, cum vero sidere. Species deinde singulae Cometarum, aliquod aliud accidens, ut motum, causam, barbam, adiciunt. Figura autem capitis, licet e longinquo sphaerica appareat, quia distantia inaequalitates supprimit, & rotundat (quadratum enim, aut trilangulare, & omne angulosum, imaginem rotundi procul ostendit) saepius tamen revera non est talis.⁴⁴

Given the fact that meteors are generated by and distinguished through accidental forms, formal accounts will naturally concentrate on them. The lowest level of the classification is where the accidental form gives the meteor a name: ‘Forma meteororum igneorum, ut talium, sunt accidentia quadam, et preaesertim situs, aut motus materiali, qui meteoris tribuit nomen.’⁴⁵ A lower level of numerically distinct individuals falls out of the scope of science. Forms such as place and figure account for fiery meteors like *lancea* (light spear-like phenomena) or *trabs* (light beam-like phenomena).⁴⁶ The accidental form of local motion defines such known phenomena as the *ignis fatuus* or the *capra saltans*. The formal cause of these meteors from the uppermost region is expressed, in the same vein, as ‘figura, aut motus, qui proximum fundamentum similitudinis sit, cum re alia, cuius meteorum adoptavit nomen.’⁴⁷ Specifying accidental forms are mostly dynamic forms of all kinds, reducible to motion, as in the case of storms and in that of the *ignis fatuus*, but they can also be one of the tangible qualities, viz. heat or cold. Storms are explained as: ‘materia enim est exhalatio, sed paullo

⁴⁴ *Meteor.* III, 3, p. 125.

⁴⁵ *Meteor.* II, 1, p. 34.

⁴⁶ According to U. Dall’Olmo, ‘Latin Terminology Relating to Aurorae, Comets, Meteors and Novae’, *Journal for the History of Astronomy*, 11 (1980): pp. 10–27, a helpful guide into these terms.

⁴⁷ *Meteor.* II, 5, p. 78.

tamen crudior; forma, explosio illa e nubibus, et motus deorsum.⁴⁸ Ignis fatuus: ‘material eius, exhalation pinguis et viscosa; forma, saltus ille in modum hominis fatui.’⁴⁹ The form of hail is a tangible quality: the cold rigidity that separates it from rain (‘rigor ille glacialis, qui discriminat a pluvia’).⁵⁰ Sometimes the explanation is minimal or redundant: the form of rain is nothing more than the fall of drops of water (‘lapsus per guttas et stillicidia’).⁵¹

With regards to the substantial form inherited from the element, recognizing it is not always simple. Because meteors are imperfect bodies or aggregates (*compositum accidentarium*), their substantial form is difficult to be traced to one single element. Their substantial form can be *multiple*, says Fromondus. Sometimes it consists of an imperfect mixture of the forms of other mixed bodies: vapours, exhalations, earth or air:

Forma enim venti substantialis eadem est quae exhalationis, et vaporis, si quis vapor permixtus est exhalationi. Unde quia vix aut numquam ventus pura exhalatione constat, multiplex est forma eius substantialis: prout sc., terrae, et aliquorum mixtorum exhalation, vapor, et aer, confuse in uno agmine venti fluxerint.⁵²

Of course, this admission of the plurality of forms in certain meteors does not constitute a departure from the Thomist requirement of the unicity of form in physical substances, since meteors are not complete substances. The plurality of forms in their case testifies for the fact that they are merely aggregates.

⁴⁸ *Meteor.* II, 4, 1, p. 73.

⁴⁹ *Meteor.* II, 1, p. 35.

⁵⁰ *Meteor.* V, 8, p. 341.

⁵¹ *Meteor.* V, 6, p. 326.

⁵² *Meteor.* IV, 3, p. 163.

4.3.3 The efficient cause

The efficient causes are responsible for extracting the meteors from elemental matter. They are of two types: immediate and instrumental (*proximae*) or remote. As already mentioned, the remote cause is traditionally assigned to the celestial bodies, while recent authors, such as Fromondus, assign it to the Sun only. The Sun communicates one of the active qualities, heat or motion, down to the sublunary region. This communication of motion from the celestial bodies down to the meteors rests on a continuity principle between the celestial spheres and the elemental spheres, which meteorological authors base on Aristotle's text from *Meteor.* I, 2:

The whole world surrounding the earth, then, the affections of which are our subject, is made up of these bodies. This world necessarily has a certain continuity with the upper motions; consequently all its power is derived from them. [339a 21–339a 23, trans. E.W. Webster.]

The communication of the active qualities downward is not directly uniform, but mediated. A standard account based on Aristotle's text is offered by Iohannes Beverus, Fromondus's predecessor from the previous century.⁵³ The celestial bodies, heating up the elements, give rise to the two exhalations, which in turn give rise to the meteors. In order to physically displace meteors from elemental matter, the celestial bodies act by introducing in it the locomotive qualities of gravity and levity. The two locomotive qualities provoke the

⁵³ Beverus, *Commentarius*, pp. 244–7.

rarefaction or condensation of the elements and, consequently, their up-and-down motion. This motion (*motus sursus et deorsum*) mixes the elements with the matter from the median or the superior region, to finally produce the meteor. Beverus remarks that in the end, through all this mediation, it is the celestial bodies that act as the proper efficient cause ('constat ea [corpora coelestia] esse causas efficientes impressionum meteorologicorum'). To round up the account of the *causa remota*, the communication of efficiency from the celestial spheres is linked with the final cause. Not only do the celestial bodies communicate motion in virtue of this continuity, but they also 'direct' the sublunary bodies to their proper ends, an end submitted to the same continuity principle between the sublunary and the celestial, as Beverus explains:

Quod cum ita sit, necessario est (inquit Aristoteles) mundus iste supernis lationibus fere continuus, ut inde vis eius universa regantur: hoc est, necesse est elementarem regionem una cum mistis corporibus quae in ea sunt, contiguam esse atque coniunctam corporibus caelestibus perpetua conversione motis, ut ab illis cuncta corpora subiecta gubernentur, mutantur, efficaciam movendi accipiant, & ad suos fines dirrigantur.⁵⁴

⁵⁴ *Commentarius*, p. 244. For alternative accounts, see Themon Judaeus, *Meteor.* I, q. 1 or Saint Thomas, *Meteor.* I, 2, n. 3: 'Et dicit quod necessarium est quod iste mundus inferior consistat ex quatuor elementis, sic continuatis superioribus lationibus, idest corporibus circulariter motis: continuum autem hic accipit pro contiguo, ut scilicet nihil sit medium inter ea. Cuius quidem necessitatis ratio est, non solum quia impossibile est locum vacuum esse, unde corpora oportet corporibus contiguari: sed etiam propter finem, ut scilicet tota virtus inferioris mundi gubernetur a superioribus corporibus, quod non esset nisi se tangerent; oportet enim quod agens corporale tangat passum et motum ab ipso.'

The thesis of the influence of the heavens on the sublunary world is still universally accepted in the seventeenth century, with a certain reductionist tendency. The Collegium Conimbricense single out the Sun among the celestial bodies, without excluding others ('hoc vero maxime praestant sua vi et influxu corpora coelestia'),⁵⁵ while in Fromondus the Sun is the only celestial body exercising influence. Beverus is not a reductionist. He notes that the opinion according to which celestial bodies can also produce other influences responsible for the generation of some wonderful effects such as that of a half-snake–half-mineral body, or any other uncommon things that one finds in the deep depths of the earth, has been derided by Pico della Mirandola and some others, that want to reduce the efficient cause of the celestial bodies to motion and heat ('non enim audiendi sunt illi, qui influentias rident ac negant, omnia videlicet lumini & motui tribuentes, inter quos Picus').⁵⁶ Beverus believes nevertheless in the occult 'spiritual quality', defined as 'qualitas quaedam spiritualis nullo modo sensu perceptibilis, & quae nullo obstante corpore quantumcunque denso & opaco impediri potest'. The argument for its existence is precisely that in the depths of the earth celestial light and motion do not penetrate: how are we to explain then the half-snake-half-stone effect? Whereas Fromondus reduced the celestial efficient influence to that of the heat of the Sun, half a century earlier more potent influences of the celestial bodies were thought to be acting in Leuven.

But not just in Leuven. A different answer to subterranean meteorological bodies such as the half-snake-half-stone would be to put efficiency in the depths of the Earth itself. Fromondus devotes an entire chapter to refute the concurrent opinion of the efficacy of subterranean fire and of its power to provoke meteors, a view advanced by Georgius Agricola and Thomas Lydiat.⁵⁷ Leaving Beverus's

⁵⁵ *Meteor.* I, 1, p. 5.

⁵⁶ *Commentarius*, p. 248.

⁵⁷ G. Agricola, *De ortu & causis subterraneorum libri V* (Basel: Froben & Episcopius, 1546); Thomas Lydiat, *Praelectio astronomica de natura coeli & conditionibus elementorum: Item Disquisitio physiologica de origine fontium perennium frigidorum et calidorum* (London: ex officina Nortoniana, 1605). See R. Vermij, 'Subterranean Fire. Changing Theories of the Earth during the Renaissance', *Early Science and Medicine*, 3 (1998): pp. 323–47.

snake-stone aside, the phenomenal premise here is that, given the ubiquity of recent reports on volcanoes and subterranean fire, it is credible that we must suppose other such phenomena, even where we do not witness an open fire at the surface of the earth. A report by Thomas Fienus testifies the presence of subterranean fires: on a clear blue sky, Fienus has seen some mysterious vapours rising quickly in the middle of the sea. Since the serenity of the sky does not last long on the Belgian shore, these vapours have disappeared very quickly, but one is to assume that it was the effect of a subterranean fire, because they reached a height superior to that of a man's head rising above the water.⁵⁸

Fromondus argues, nevertheless, against the efficient causality of subterranean fires as a primary cause for meteors with, passages from Aristotle and from the Scripture. 'Aristotelis tamen nostri sententia est, Solem esse principem causam, & maxime universalem, vaporum & exhalationum. Ubique enim eius meminit; ignis subterranei, parcissime.'⁵⁹ He brings forward numerous experiences that can only be attributed to the Sun's influence: the motion of the winds, the reabsorption of morning dew, rainstorms or lightning. Though one cannot exclude the presence of small subterranean fires, like those in Fienus's report, or that of volcanoes, the overwhelming majority of meteorological phenomena happen because of the Sun's influence. The real danger Fromondus identifies in Agricola's view is that of the proliferation of subterranean fires to the point where the Earth becomes animated, and he also expresses discontent with regards to Kepler on this point. For Agricola, reports Fromondus, the Earth is like an animal body, heated by a heart, releasing his spirits through the arteries. Like an animal, it exhales the natural heat of its viscera not so much through manifest orifices such as the nostrils, but through a multitude of invisible channels, its pores. Its surface is similar to the membrane of the brain that acts like a sieve for the passing of the animal spirits. The Earth has also many very subtle channels of air-vents, through which very subtle breezes pass, as in respiration. 'Similitudo etiam terrae cum animali, non convenit', concludes Fromondus. The animal is

⁵⁸ *Meteor.* I, 4, 1, 24–6

⁵⁹ *Meteor.* I, 4, 1, p. 26

heated everywhere, according to medicine, whereas the Earth has manifestly cold parts inside, alongside more heated ones.

At the other extreme, others have argued for attributing a power to the Sun stronger than what we know from Aristotle. Fromondus also rejects Scaliger's magnetic power, which would attract directly the vapours instead of letting them pass through the mediating process of rarefaction. He dismisses the opinion briefly: 'Non scandunt vapores & exhalations, attracti virtute aliqua magnetica Solis, ut Scaliger credit; sed dissoluta elementi densitate, sponte sua movent pedem, sive succollantur a propria levitate.'⁶⁰ To sum up, Fromondus does not shy away from incorporating new findings, such as Fienus's reports, but one should not test the limits of reasonability, usually clearly marked by Aristotle.

4.3.4 The proximate causes

Aristotelian efficient causes act usually through instruments. The generally shared doctrine is that heat and motion are the proximate efficient causes, also called instrumental because they are used by the *causa remota* to produce effects. Fire is a 'main cause', while the heat through which it acts is the instrumental cause. Similarly, heat pervades water and earth and gives rise to the two *halitus*, which rise in virtue of their newly acquired levity, where levity is the instrumental cause.⁶¹

According to Beverus, there are three types of instrumental causes that concur in the production of the meteors, transforming motion into heat.⁶² One is

⁶⁰ *Meteor.* I, 4, 2, p. 33.

⁶¹ See, for instance, the explanations given by Eustachio a Sancto Paulo, *Summa philosophiae quadripartita* (Paris: Chastellain, 1609), vol. 3, pp. 59–61, 'Quid et quotuplex sit causa efficiens': 'Tertia in principalem et instrumentalem. Illa est quae vi sua producit effectum, haec vero quae non nisi in virtute alterius operatur; sic enim ignis principaliter, calor vero instrumentaliter ignem general.'

⁶² Beverus, *Commentarius*, p. 247.

the motion of the celestial intelligences, which heats the heavens and the fire from the superior region (see Aristotle, *De Coelo*, I, 2). A second instrumental cause is the diurnal cyclic motion of the skies (see Aristotle, *De Coelo*, II, 7), which carries along the inferior cooling and heating celestial bodies. The third instrumental cause is light, a body that produces and communicates heat from itself.

Proximate causes are traceable either to heat and cold, and in this case they act through rarefaction and condensation, or to local motion, stirred by one of the locomotive qualities, gravity or levity. The locomotion that gravity and levity produces is directed by the arrangement of elements in concentric spheres circumventing the earth and giving them a natural place. The meteors move upward and downward, according to the gravity or levity proper to the particular elemental mixture that they have, and are attracted by the place of the predominant element.

Gravity and levity are the qualities that can produce local motion intrinsically, through displacement of parts. Heat and cold, by themselves, cannot. They can only produce motion through the mediation of levity or gravity, by inducing these qualities in the mobile. ‘Calor non est virtus per se locomotiva’, say the Conimbricenses.⁶³ In Fromondus, this principle comes about, for instance, when he is arguing against the assignation of the cause of the motion of the winds to the coldness of the median region expelling the exhalation from the clouds:

Dico secundo: nec frigus mediae regionis habet propriam vim repellendi exhalationem calidam. Probatur, quia inter qualitates primas non est talis antipathia, qua se virtute aliqua loco motiva abigant et repellant, ut magnete aliqui ferrum, et aqua ignem, ante qualitatum primarum actionem et reactionem: quod non experimur.⁶⁴

⁶³ Collegium Conimbricense, *Meteor.* I, 1, p. 6.

⁶⁴ Fromondus, *Meteor.* IV, 2, 2, p. 152.

An example of the process of the complex composition of meteorological motion can be taken from the case of lightning. The proximate cause of lightning is the actual kindling of the exhalation, which, because of rarefaction, will try to evade from the clouds; the remote cause, the Sun, directs the motion of the the kindled exhalation downward (as opposed to any other direction).⁶⁵ The two causes therefore concur to produce the final form of the meteor, defined as ‘a lighted exhalation moving downward’.

Separated from the process of inducing levity and gravity, another prominent efficient cause of motion is the old Aristotelian concept of *antiperistasis* (the increase of a quality in contact with the contrary quality, as per *Phys.* III, 5), which is endorsed by Fromondus. Storms are said to be produced by the antiperistasis of cold in the clouds.⁶⁶ A good example is the formation of hail through the action of the surrounding warm air, which makes a cold cloud even colder and thereby produces hail. This effect is proven from the fact that there is more hail produced during the summer than in winter.⁶⁷

The hylomorphic structure is essential in accounting for the efficient cause producing the meteors. Although there are other causes, most meteors are caused by the quality of heat and by its effect, local motion (also a quality). Local motion is extrinsic to the sublunary world altogether, as we have seen, and is communicated from one body to another, but this communication is mediated by the two locomotive qualities, gravity and levity. The primary qualities of heat and motion also act on other bodies, by inducing a form in them, on the Aristotelian principle that a form generates another form through its likeness (*Metaph.* IV, 5): the hotness of a body is transmitted to another body, and cold makes a warm body colder. Heat is the primary cause of the differentiation of vapours and exhalations from the heavy elements. Both heat and local motion alter the elemental matter by introducing unnatural ‘foreign’ qualities. *Praeter natura* heat and *praeter natura*

⁶⁵ *Meteor.* II, 2, p. 45. ‘[Causa efficiente] duplex est, proxima et remota. Haec est, quae exhalationem accendit, illa, quae accensam deorsum torquet.’

⁶⁶ Fromondus, *Meteor.* II, 4, 1, p. 73.

⁶⁷ *Meteor.* V, 8, a. un., p. 341. ‘Antiperistasis imi aeris sola caussa est, cur aestas frequentius grandine, quam hiems, lapidetur.’

motion are terms that indicate the extrinsic origin of these qualities ('Si autem motus ille contra aut praeter naturam est, ergo ab aliquo extrinsecus impellente fit'; '[metheora] calidi sunt, a calore externe eos resolvente, et contra naturam'), thus defining the meteor as an element corrupted by a foreign quality.⁶⁸ And as we have seen, the transmission of motion is split between the governing causality of the remote cause and the instrumental causality of the proximate cause. Gravity and levity are not cases of external locomotion, nor are they transmissible in the sense of *causing* other bodies to move like billiard balls. A mover acts on the *qualities* of a moved body and these induced qualities causes the moved body to move, as if intrinsically. Gravity and levity are sometimes called secondary to elementary qualities, precisely in the sense that the elementary qualities *produce* gravity and levity.⁶⁹ While the assignation of the efficient cause of the meteors to local motion displacing elemental matter may seem similar to the Cartesian account, the process in itself is quite different, dependent on the ontological structure of bodies and the qualities attached to them.

Conclusion

Fromondus does not take a strong stand in ontological debates such as those considered in the previous chapters. He is little preoccupied by the permanence of the elements in the mixture, by the primary or secondary status of gravity and levity or by the qualitative distinction between the meteors and the four elements.

⁶⁸ *Meteor.* IV, 1, 1, 148 and *Meteor.* I, 3, 19.

⁶⁹ For reference, see C. Javelli, *Epitome in universam Aristotelis Philosophiam, tam naturalem, quam transnaturalem* (Venice: s. n., 1555), vol. 3, pp. 102–3: 'Gravitas et levitas sunt qualitates naturaliter posteriores caliditate et frigiditate, humiditate, siccitate. Probatur, calefaciens primo intendit producere caliditatem, quam omne agens sibi simile intendit, ad quam caliditatem generatur gravitas vel levitas, secundum quod exigit forma substantialis rei genitae.' On the secondary or primary status of gravity and levity, the opinions are split.

His scientific interest is that of classification: the Aristotelian ontological structure of physical substance, with its array of forms, qualities and matter, serves to categorize phenomena and put them in a meaningful order, the same order that preoccupied Pázmány in structuring his teaching course and the Aristotelian corpus. Explaining the meteors means describing and cataloguing them.⁷⁰ Fromondus's careful analysis of formal and material causality, his preoccupation with distinguishing different qualities that different meteors have, and the arrangement of his book, incarnate in this sense the spirit of late Aristotelianism.

The seventeenth century continues to produce commentaries to Aristotle's *Meteorologica*, carrying forward the revival of interest in this work started in the sixteenth century and propagating the Aristotelian doctrines we have analyzed through Fromondus. It certainly was not Descartes's small treatise on the *Météores* that constituted an authority in meteorology for the seventeenth century, but books such as that of Fromondus. An example is the commentary in the form of questions published by the Lusitan doctor **Francisco Mateo Fernández Vejarano** in 1643, who still justifies his enterprise by the scarcity of commentaries devoted to *Meteorologica*, as opposed to those devoted to other books of the Aristotelian corpus.⁷¹ As the century progresses, so does the production of such works. Perhaps the most famous among them is the four-volume commentary of the Jesuit **Niccolò Cabeo**, which applied the Aristotelian conceptual framework with more flexibility to the more recent discoveries of the century.⁷² Another Jesuit father, **Georges de Rhodes**, published, on the contrary, a reactionary manual of 775 pages on the 'true peripatetic philosophy', 'the lighthouse of scholastic theology'.⁷³ He disputes, traditionally, on the nature

⁷⁰ Credit is due to Maarten Van Dyck for insisting on Fromondus's preoccupation for classification in a private discussion.

⁷¹ *Super quatuor libros meteororum Aristotelis quaestiones* (Lyon: P. Prost, 1643).

⁷² *In quatuor libros meteorologicorum Aristotelis Commentaria et quaestiones 4 tomis comprehensa* (Rome: Corbelletti, 1646). See C. Martin, *Renaissance meteorology*, op. cit., ch. 5.

⁷³ *Philosophia peripatetica ad veram Aristotelis mentem, libris quattuor digesta et disputata, pharus theologiam scholasticam* (Lyon: J.-A. Huguetan and G. Barbier, 1671).

and generation of mixtures, on the number of primary qualities and on the permanence of the elements in the mixture (he takes the traditional Thomist position on the virtual permanence of qualities). He devotes the second treatise of the second book to imperfect and perfect mixtures (pp. 371–401). Imperfect ‘meteoric’ mixtures differ from the elements only qualitatively, not substantially, as per the received doctrine. Their definition is also unsurprising: ‘mixtum istud non aliud sit quam elementum peregrinis qualitatibus infectum’ (p. 371a). The layout of the treatise is traditional: Rhodes discusses the meteors in general and then the fiery, airy, watery and earthly ones. Regarding the causes of the meteors, the formal one does not need explanation, for they keep the form of the original element. Only final causes are particular and will be treated separately. The material and the efficient cause are general: the elements, the vapours and the exhalations and, respectively, the Sun, the subterranean fires, or the stars themselves.⁷⁴ This is the common understanding of meteorology of the seventeenth century.

The evolution of the field is to be sought in the more curious meteorological books that deepen particular meteorological topics and develop them in different directions, towards fields like geography or astrology. An example is the famous *Mundus subterraneus* of the Jesuit **Athanasius Kircher** (1665). Kircher wants to profit from the recent discovery of the circulation of the blood and integrates it in the old image of the Earth as an animated organism: the skeleton is made up of its mountains, the rivers compose its arteries, the heat of the heart is manifested in subterranean fires and the tides are nothing but its breath.⁷⁵ Kircher offers an experimental natural history of this organism, with wondrous descriptions of the seabed or the Italian volcanoes he had observed, of the formation of islands and deltas, and many others. It is one of the geographical encyclopaedia of its time. The *Introductio in universam geographiam tam veterem quam novam* by

⁷⁴ ‘Ex quattuor causis istius corporis, formalis non eget explicatione, cum sit ipsa forma elementi; finalis admodum diversa est, ut ex dicendis constabit; superest ergo materia qua constat, causa efficiens a qua gignitur, locus in quo elaboratur.’ (P. 371).

⁷⁵ *Mundus subterraneus* II, 19.

Philippe Cluvier, published by Elzevier in 1629, is another geographical bestseller, with some 30 editions. The *Nova mundi sublunaris anatomia* by **Jean-Baptiste Morin**, professor at the Collège de France, is also an example that testifies for the expansion of the field, to which we can add the detailed meteorological previsions integrated among the horoscopes of his *Astrologia gallica*, part of another successful genre.⁷⁶ The evolution of meteorology in the seventeenth century beyond the genre coagulated around Aristotle's *Meteorologica* exceeds, however, our scope. The most notable change that occurs in seventeenth-century meteorology is brought over by the success of Cartesianism, which we will investigate in the next chapter.

⁷⁶ On this literature, see H. Dré villon, *Lire et écrire l'avenir: L'astrologie dans la France du Grand Siècle (1610–1715)* (Seyssel: Champ Vallon, 1996). J.-B. Morin, *Nova mundi sublunaris anatomia* (Paris: N. du Fossé, 1619) and *Astrologia Gallica principiis et rationibus propriis stabilita atque in XXVI libros distributa* (La Haye: A. Vlacq, 1661).

5 Cartesian meteors against scholastic meteors

We have examined in the previous chapters various aspects of Aristotelian meteorology, from its ontological premises decided by the reception of Aristotle's theory of mixture to the coherent shape it took in the sixteenth and seventeenth centuries. This chapter goes beyond Aristotelian meteorology and discusses the challenge raised against it by Cartesianism. Descartes's *Meteors* was a small work that passed almost unacknowledged when it appeared in 1637. As for Descartes's disciples, none of them seems to have been interested in it, and the *Principles of Philosophy* of 1644 superseded the essay. This chapter shows how original *The Meteors* was, when looked at from the perspective of the dominating Aristotelianism. I argue that *The Meteors* is part of a program of reformation of the scholastic qualitative physics already started by Descartes with the *Rules* and *The World*. In order to do so, we need to have a look at Descartes's critique of material hylomorphism.¹

Compared with other pieces of the Cartesian corpus, *The Meteors* have drawn less attention from scholars. Most of the scholarship on it has been devoted to *Discourse VIII* on the rainbow and to problems of scientific methodology.²

¹ This chapter is partly based on 'Cartesian meteors and scholastic meteors,' *Journal for the History of Ideas*, forthcoming.

² P. Mouy, 'La théorie cartésienne de l'arc-en-ciel: ses origines, son développement', *Travaux du IXe congrès international de philosophie. Congrès Descartes* (Paris: Hermann, 1937), vol.

Nevertheless, Descartes himself thought of his work as providing a revolutionary step forward with respect to the contemporary meteorological treatises available. More importantly, *The Meteors* constitute a large part of the first public presentation of Descartes's physics in the *Essays* of 1637. Étienne Gilson's 1920 article, 'Météores cartésiens et météores scholastiques', remains the only thorough study devoted to the content of the meteors in general.³ We will follow Gilson's lead and provide a historical assessment of the meteors, both with respect to contemporary meteorological knowledge and with respect to the development of Descartes's thought.

Descartes's rejection of real qualities is a hallmark of his anti-scholastic rhetoric. While he initially avoided expressing an outright rejection of real accidents, mainly for theological concerns, the discussion breaks into the open in the *Replies* to the *Meditations* of 1641. According to this text, Descartes's argument against material hylomorphism proceeded from his commitment to the real distinction between body and mind. His most famous critique against the *entia philosophica* that populate scholastic physics—qualities and substantial forms—is that these concepts arise from a deep-rooted prejudice: the Aristotelians confuse things that pertain to the mind with things that pertain to the body and falsely attribute affections of the mind to material bodies.

2, pp. 47–53; C. B. Boyer, 'Descartes and the radius of the rainbow', *Isis* 43 (1952), pp. 95–8; J.-R. Armogathe, 'L'Arc-en-ciel dans les *Météores*', in *Le Discours et sa méthode*, ed. by N. Grimaldi and J.-L. Marion (Paris: Presses Universitaires de France, 1987), pp. 145–62; D. Garber, 'Descartes and Experiment in the *Discourse* and *Essays*', in *Essays on the Philosophy and Science of René Descartes*, ed. by S. Voss (New York and Oxford: Oxford University Press, 1993), pp. 288–310; M. Blay, *Les figures de l'arc-en-ciel* (Paris: Carré, 1995) and his introduction to *The Meteors* in Descartes, *Œuvres complètes III* (Paris: Gallimard, 2009), pp. 265–83; J.Z. Buchwald, 'Descartes's Experimental Journey Past the Prism and Through the Invisible World to the Rainbow', *Annals of Science* 65 (2008): pp. 1–46.

³ In *Études sur le rôle de la pensée médiévale dans la formation du système cartésien*, (Paris: J. Vrin, 1930), pp. 102–37 (initially published in 1920 and 1921 in *Revue d'Histoire de la Philosophie*). Gilson can be completed with E. Lojacono's edition and notes of *The meteors* in Descartes, *Opere scientifiche*, vol. 2 (Torino: UTET, 1983).

However, it is difficult to assign this line of argument to the corpus prior to the *Meditations*, while Descartes's rejection of Aristotelian real qualities is manifest throughout his earlier writings. I will analyse Descartes's anti-hylomorphism in *The Meteors* published in 1637 and in the unpublished works that precede it, *The World (Treatise on Light)* and the *Rules for the direction of the mind*.

Firstly, I will retrace the project and the reception of the meteors, in order to establish that one of the central points of conflict between Descartes and his scholastic readers was the ontological status of real qualities. In order to do so, we will use Fromondus's *Meteorologicorum libri sex*, analysed in the previous chapter, as a term of comparison. In *The Meteors*, Descartes wanted to publish a sample of non-scholastic physics that uses mechanical explanations instead of hylomorphic notions. In spite of Descartes's statements that he did not want to openly provoke the School, I take Descartes's rejection of real qualities to be an underlying motivation for the publication of *The meteors*. I emphasize the gravity of Descartes's position by establishing the central role that the real qualities play in contemporary Aristotelian meteorology.

In a second step, I will present Descartes's arguments against real qualities in *The World* and in the *Rules for the direction of the mind*, connecting them with the more famous argument provided in the *Sixth Set of Replies*. I claim that Descartes's nominalist position with respect to the accidents of the *res extensa* is decided very early, on epistemological grounds, before the metaphysical elaboration of the thesis of the real distinction of substances from the *Meditations*. I take this priority to be both historical and conceptual. I conclude that Descartes's preoccupation with the nominalist reduction of real qualities is an essential part of the development of his early physics.⁴

⁴ On the notion of real qualities, see S. Menn, 'The Greatest Stumbling Block: Descartes's Denial of Real Qualities', in *Descartes and His Contemporaries: Meditations, Objections, and Replies*, ed. by R. Ariew and M. Grene (Chicago: University of Chicago Press, 1995), pp. 182–207. On the historical development of accident realism, see R. Pasnau, *Metaphysical Themes*, pp. 190–204 *passim*. On Descartes's hylomorphism, see also the recent treatment of

5.1 An unwelcomed book

Descartes's interest in the meteors was triggered by one unusual phenomenon, the parhelia observed in Rome in 1628 by Christoph Scheiner. Descartes thought at that time to make a 'small treatise' that would examine not only optical phenomena, but also 'in general all sublunary phenomena.'⁵ The project extended to a treatise on light (presumably *The World*) that would comprehend *all* natural knowledge.⁶ In 1635, after *The World* was abandoned, *The Meteors* is presented as a single work.⁷ The essay was published in 1637 as 'a sample of philosophy'⁸ among others, together with *The Discourse*, *The Dioptrics* and *The Geometry*. The structure of the essay follows that of contemporary textbooks and Descartes respected, to a large extent, the order of topics normally used.⁹ In the correspondence, he presented the work as a possible replacement for the teaching manuals on meteorology, especially those used in the Jesuit schools.¹⁰

H. Hattab, *Descartes on Forms and Mechanism* (Cambridge: Cambridge University Press, 2009).

⁵ AT I 23.

⁶ AT I 70.

⁷ AT I 329–30.

⁸ AT I 23.

⁹ See AT XII 204–5 (quoting summaries of books by Eustachius a Sancto-Paolo and Charles-François d'Abra de Raconis); É. Gilson, 'Météores cartésiens et météores scolastiques' (a comparison with the Conimbricenses); J.-R. Armogathe, 'L'Arc-en-ciel', pp. 159–62 (a comparative table between the Conimbricenses, Descartes and Fromondus); and our discussion of Fromondus in chapter 4.

¹⁰ See É. Gilson, *La liberté chez Descartes et la théologie* (Paris: F. Alcan, 1913), pp. 319–32, on Descartes's attempt of introducing his philosophy in the Jesuit colleges.

After the *Essays* of 1637 were published, Descartes sought the approval of the Jesuits. He wanted to publish a set of objections appended to the book in a subsequent edition, like he will do later for the *Meditations*. The fact that he gave up this plan suggests that the objections received were dissatisfying. Descartes tried to use Father Noël as a promoter that would show around his treatise in the Society and would send him back comments from members.¹¹ In his letter to him, Descartes insisted on *The Meteors*: ‘particularly for *The Meteors*, I do not know how they will teach it from now on, as they do each year in your establishments, without either refuting or following what I write on this subject’.¹² At one point, not receiving the enthusiasm he was expecting, Descartes asked Mersenne to enquire about the disputations that the Jesuits were holding, in order to see if they had discussed his book.¹³ He sent further copies to Father Vatier; Father Ciermans of the Society in Leuven wrote back to him extensively on colours and on his account of the rainbow; another one of his former teachers from La Flèche, Father Fournier, showed some admiration for the work, which extended even to what we would now call plagiarism. But the general reception in Jesuit circles was underwhelming.¹⁴ Father Ciermans congratulated Descartes for being a pioneer of a new world in meteorology by rejecting real qualities, although in the end he also questioned this radicalism.¹⁵

Descartes was soon disenchanted by the lack of enthusiasm from the Jesuits. He wrote to Huygens (in a passage that was left out from the letter sent) that the book was perhaps too much for the School:

¹¹ AT I 383.

¹² AT I 455.

¹³ AT II 267–68.

¹⁴ See G. Rodis-Lewis, ‘L’accueil fait aux *Météores*’, in *Problématique et réception du Discours de la méthode et des Essais*, ed. by H. Méchoulan (Paris: J. Vrin, 1988), pp. 99–108; R. Ariew, ‘The first attempts at a Cartesian scholasticism: Descartes’s correspondence with the Jesuits of La Flèche’, in *La biografia intellettuale de René Descartes attraverso la Correspondance*, ed. by J.-R. Armogathe, G. Belgioioso, and C. Vinti (Naples: Vivarium, 1999), pp. 263–86.

¹⁵ AT II 55–56 and 59.

As for my book, I don't know what opinion the general public (*gens du monde*) will have on it; but in what regards the Schoolmen, I understand that they keep silent, and, bothered by the fact that they don't find in it enough ground to exercise their arguments, they limit themselves to say that, if what it contains were true, than all their philosophy would have to be false.¹⁶

A long dispute with Father Bourdin, started in 1639, precipitated the end of this campaign, and at one point Descartes accused Bourdin for being directly responsible for the failure of his *Meteors*.¹⁷ When publishing the *Meditations*, Descartes changed tactics and decided to exploit the rivalry between the Society and the Sorbonne (though without much success). The Jesuit reception suggests that *The Meteors* were perhaps more provoking than Descartes presented them to be.

The main objection raised against *The Meteors* was the lack of proper demonstrations or experiments. But there was also a polemical dimension in the book that could have triggered the reserve of an Aristotelian natural philosopher. After his hopes of having the book accepted by the Jesuits were dashed, Descartes recognized publicly in the *Lettre-Préface* to the French *Principes* that 'in *Meteorology* I wanted people to recognize the difference that exists between the

¹⁶ 'Pour mon livre, je ne sais quelle opinion auront de lui les gens du monde; mais pour ceux de l'Ecole, j'entends qu'ils se taisent, et que faschés de n'y trouver pas assez de prise pour exercer leurs arguments, ils se contentent de dire que, si ce qu'il contient était vrai, il faudrait que toute leur philosophie fût fausse.' (AT II 48).

¹⁷ AT VII 573. On Bourdin, see R. Ariew, 'Pierre Bourdin and the seventh objections', in *Descartes and His Contemporaries*, pp. 208–25.

philosophy I practice and that which is taught in the Schools, where the same subject matter is normally dealt with'.¹⁸

This polemical dimension is transparent throughout the essay, but one of the most important innovations of the treatise is an open rejection of the scholastic distinction between perfect and imperfect mixtures. Descartes wrote in *Discourse I*:

I shall take the opportunity to pause a little and describe salt, and to see if in it we can ascertain the form of these bodies that the philosophers hold to be composed of a perfect mixture of the elements, as well as those of the meteors, which they say are composed of the elements in an imperfect mixture.¹⁹

This text marks a direct opposition with 'the Philosophers'. Descartes will never look for the 'forms' of bodies, quite the contrary. The theory of mixtures is fundamental for any Aristotelian account of body and matter, not to mention particular sciences such as alchemy or medicine. Moreover, as we have seen, the distinction between imperfect mixtures (aggregates) and perfect mixtures (endowed with true substantial unity) is omnipresent in contemporary textbooks from the first pages. A look into the way in which the concept was used by the Aristotelians will highlight the gravity of Descartes's rejection of this particular notion.

An important reference for Descartes's *Meteors* is Libertus Fromondus's book that we have examined in the previous chapter. Fromondus is also the first reader to have given thoughtful comments on the *Essays*. In 1637, he had just taken the charge of ordinary professor of theology in Leuven and was known mostly as a respected man of science, preoccupied by astronomy and meteorology. Jean-Robert Armogathe has suggested that Descartes's treatment of the rainbow

¹⁸ CSM I 187 / AT IX 15.

¹⁹ Olscamp 263.

in *Discours VIII* may have been inspired by Fromondus's and that he used his book for empirical material.²⁰ Fromondus's *Meteors* was precisely a typical Aristotelian treatise of the kind that Descartes aimed to eventually replace.

Let us recall Fromondus's definition of the meteors:

The Philosophers however define their meteor as an imperfectly mixed body, raised in the air out of a vapour or out of an exhalation. . . . The imperfect body is nothing else than an Element corrupted by foreign qualities. Such as heated water, ice, snow, hail, etc. . . . Therefore this imperfect mixture is a union (*coniunctio*) of a foreign quality with a natural quality in their element. . . . In this a way, namely, the mixture of four degrees of heat with four degrees of cold makes warm water an imperfect mixture. This mixture is called imperfect because it does not attain the perfection of the proper mixture (*temperies*), which drives out the substantial form of the element and introduces perfectly the form of the mixed body.²¹

Fromondus's definition is based on the qualitative distinction in the composition of matter that we have analysed, and which Descartes rejected. Imperfect mixtures, it is worth recalling, are sublunary bodies that have not yet

²⁰ J-R Armogathe, 'L'Arc-en-ciel dans les *Météores*'.

²¹ 'Philosophi vero Meteorum suum definiunt, Corpus imperfecte mixtum, ex vapore vel exhalatione ortum in sublimi . . . Corpus imperfecte mixtum, nihil aliud est, quam Elementum infectum qualitatibus peregrinis. Talis aqua calefacta, glacies, nix, grando, &c. . . . Mixtio igitur imperfecta hîc, est coniunctio qualitatum peregrinarum cum naturalibus in eorum elemento . . . Sic enim mixtura quatuor graduum caloris cum totidem frigoris, aquam tepidam, imperfecte mixtam facit. Haec mixtio vocatur imperfecta, quia nondum attingit perfectionem temperiei, quae formam substantialem elementi expellat, & absolute mixti introducat.' (*Meteorologicorum libri sex*, pp. 1–2).

acquired a substantial form of their own, unlike perfect mixtures. The meteors are, in other words, imperfect substances, in an intermediary state between pure elements and complete stable bodies that can be defined by their own substantial form. As Fromondus explains, heated water or rain are imperfect mixtures that retain the form of elemental water, while frogs that fall from the sky are not meteors, but perfect mixtures, because they have their own substantial form.²²

The previous chapters have shown that Aristotelian meteorology is not a science of sublunary atmospheric events, but a science of a certain type of mixtures. Not everything that arises in the atmosphere is a meteor and not all meteors arise in the atmosphere. This delimitation of meteorology as the science of imperfect mixtures within the body of Aristotelian physics was firmly established by the early seventeenth century, and it endured well into the century.²³ Even Leibniz uses this notion to mark his distinction between aggregates and *unum per se* substances.²⁴ Equally important, as we have seen with Pázmány, for late Aristotelianism the ontology of mixtures serves as the basis for the arrangement of the course on physics in the proper order (*ordo doctrinae*): the imperfect mixtures (the meteors proper) are dealt with in the class on the first three books of *Meteorologica*, while the perfect mixtures (e.g., minerals) are dealt with in the class on the fourth book of *Meteorologica*; classes on *De anima* and on the rest of the physical books continue with the study of the animated perfect mixtures (see chapter 3).

The corpuscular theory of matter from *Discourse I* of Descartes's *Meteors* replaced the articles on the doctrine of mixtures that would start an Aristotelian treatise. Descartes's meteors are no longer defined by their ontological specificity as imperfect substances; they are bodies no different than other bodies. As such, *Discourse I* is undermining the very definition of the field, as it was understood in

²² *Meteorologicorum libri sex*, p. 2.

²³ Cf. R. Goclenius, *Lexicon philosophicum* (Frankfurt: M. Becker et al., 1613), p. 693; E. a Sancto Paolo, *Summa philosophiae quadripartita*, (Paris: Chastellain, 1609), pp. 222–4; C.-F. d'Abra de Raconis, *Tertia pars philosophiae seu Physica* (Paris: M. Henault, 1633), pp. 463–4; É. Chauvin, *Lexicon philosophicum* (Leeuwarden: F. Halma, 1713), p. 403b; etc.

²⁴ Leibniz, *New Essays* III, 6, 42.

the School. In this sense, it is remarkable that, although Descartes started his investigation with the optical meteors in 1629, according to the correspondence, in the published essay he kept their place at the end of the treatise, just like the rival manuals do. However, in the scholastic manuals, the optical or ‘emphatic’ meteors are treated last because they are not real meteors, but only appearances, while Descartes discarded this distinction. Descartes's tactics is to mimic the familiar structure of contemporary books, while changing their content.

The fact that Descartes’s rejection of the theory of perfect and imperfect mixtures derives from a denial of hylomorphism as a description of material bodies would have been transparent enough for an Aristotelian reader. But the non-use of real qualities had also more specific scientific consequences. Fromondus’s comments on Descartes’s *Meteors*, to which I now turn, show with more precision how deep the divide was between the Cartesian meteors and the Aristotelian meteors.

5.2 A salty taste

When Fromondus was asked to give his opinion on the *Essays* of 1637, he replied with a general critique and a number of detailed objections on *The Discourse*, on *The Dioptrics* and on *The Meteors*.²⁵ The brief exchange between Descartes and him, carried out through Fromondus's former student, Fortunatus Plempius, circulated in learned circles.²⁶ As Daniel Garber has shown, Fromondus saw Descartes as one of the Anti-Aristotelians against which he had been arguing throughout his career.²⁷ With a generally polite tone, but not devoid of irony, he

²⁵ AT I 402–9.

²⁶ See the comments of Charles Adam in AT XII 241.

²⁷ See D. Garber, ‘Descartes, The Aristotelians, and The Revolution That Did Not Happen In 1637’, *The Monist* 71 (1988): pp. 471–86. See also G. Rodis-Lewis, ‘L’accueil fait aux

accused Descartes of falling, without realizing it, into the physics of Epicurus, and he sent him the treatise against atomism that he had written, *Labyrinthus sive de compositione continui* (1631). He compared Descartes to fool Ixion holding a cloud in his arms instead of Juno.²⁸ Although Baillet claims ‘a close friendship’ between him and Descartes, probably misled by Descartes's own statements,²⁹ Fromondus's anti-Cartesianism developed over the years, as we will see in our study of the Leuven reception of Descartes from chapter 6.

One of the many technical points discussed in the exchange is the account of the formation of sea salt—a traditional topic taken from Aristotle's *Meteorologica* II, 3. Unexpectedly for the reader, Descartes introduces in his account on sea salt a digression on sensible qualities, a topic belonging to books on *De anima* that one would not normally find in a meteorology book. Descartes provides an analysis of a quality, salty taste, in corpuscular terms (sharp shaped particles are kept by the interstitial subtle matter in perpendicular position while entering the pores of the tongue, and thus provoke the specific taste).³⁰ Fromondus objects that Descartes's account cancels the qualitative distinction between salt and seawater, reducing it to a mere difference between sharper and smoother particles. Fromondus, who was familiar with atomism, was sensible to these types of arguments that explain the qualities of bodies through a supposed invisible material structure. He provides a classical argument against material atomism, the regress argument against cohesion: the little hooks through which Descartes explains the cohesion of bodies would have to be in turn explained by littler hooks, and so on.³¹ Fromondus singles out this account as a symptom of Descartes's entire approach and he qualifies Descartes's theory of matter as ‘nimis crassa et mechanica’; not using real qualities made physics unintelligible for him (‘aut nihil intelligo’):

Météores’, and the annotations of M. Blay and F. De Buzon in Descartes, *Œuvres complètes III*, pp. 684–701.

²⁸ AT I 402.

²⁹ See AT I 475 and AT II 48–9.

³⁰ AT VI 250.

³¹ AT I 406.

What a paradox, again, when he states at p. 162 that the same corpuscles produce the sensation of cold when they strike gently the tactile sense, and the sensation of heat, when they strike it harder! As if there would be really that much of a difference in that local impulse, and not in the qualities themselves that affect the tactile organ in different ways!³²

And he insists:

At 174 and 189 he says that seawater appears salty because the thicker particles of water fall into the pores of the tongue with their sharp end rather than with an oblique fall. As if it would have a different taste, if by chance the particles would push into the organ of taste with their horizontal end! He hopes to explain too many things only through position (*situs*), or local motion, things that cannot be explained without other real qualities—or I do not understand anything.³³

³² 'Quam etiam paradoxum quod pag. 162 ait, eadem corpuscula, si languide impellant sensum tactus, gignere frigoris sensationem, et caloris, si fortius impellant! Quasi vero tantum differentiae sit in illo impulsu locali, non in qualitatibus ipsis diversimode afficientibus organum tactus!' (AT I 407).

³³ 'Pag. 175 et 189 docet aquam maris apparere salsam, quia partes aquae crassiores punctim potius quam transversim incidunt in poros linguae. Quasi alio sapore tincta appareat, si casu transversim partes illae organo gustus incumbant! Nimis multa sperat se expediturum per solum situm, aut motum localem, quae sine realibus qualitatibus aliis non possunt, aut nihil intelligo.' (AT I 408).

At the explanatory level, Fromondus's and Descartes's parallel accounts of various meteorological phenomena may seem similar or interchangeable, as it has been argued by Craig Martin, and we have seen in the previous chapter that Fromondus too used figure and motion to describe the meteors.³⁴ Both authors appeal to qualities or properties to explain the behaviour of bodies. In Fromondus's case, the explanation of a certain behaviour stops at the level of the quality. In Descartes's case, the explanation goes further down, to explain the quality through a material composition or another (either particles of a certain type or an elementary mixture of a certain type). While it may be that the actual explanatory accounts of the natural effects change little, the concept of quality changes in a radical way, and this is what Fromondus is protesting against. For Descartes, the quality of salt is not a *real* quality because it can be fully reduced to the arrangement and configuration of particles. It is just a name that we give to that particular material configuration. For Fromondus, although salty taste is also the result of a certain material configuration, it is not explainable through that alone. The taste is the result of the 'quality itself' ('in qualitibus ipsis', he writes). For him, the quality is ontologically real because it produces an effect into the world.

Fromondus emphasized this critique a number of times in his letter. Although *The Meteors* is silent about the reality of qualities so as 'not to break the peace with the philosophers,'³⁵ in the correspondence from those years Descartes develops quite explicitly his view on real qualities.³⁶ When reflecting back on *The Meteors* later in his career, Descartes himself takes the example of salt to be paradigmatic for his approach to natural philosophy. In the comments he made in

³⁴ C. Martin, *Renaissance Meteorology*, p. 136, notes that 'many of Descartes's explanations are nearly interchangeable with Aristotelian ones'. This assesment seems to me exaggerated.

³⁵ AT VI 239.

³⁶ See letter to Renieri for Pollot, April or May 1638, AT II 43–4, or a letter to Mersenne, 13 July 1638, AT II 223, on weight. See also A. Hütemann, 'Descartes' Kritik an den realen Qualitäten: das Beispiel der Schwere', in *Archiv für Geschichte der Philosophie* 83 (2000): pp. 24–44.

1642 on Regius's defence against Voetius, Descartes refers back to his treatment of salt in *The Meteors* as an example of how to avoid forms, by submitting them to 'mathematical reasoning'.³⁷

One can certainly oppose a doctrine by ignoring it and propose a parallel one, in the hope that the superiority of the proposal will speak for itself. This appears to have been the project of the meteors: to present an alternative mechanical meteorology shaped in a recognizable form that, while not overtly opposing the real qualities, would render the notion redundant. But in order to discern how it is that Descartes arrived at rejecting real qualities in the first place, it will be useful to look for arguments against the reality of accidents in the texts prior to *The Meteors*. In these texts, Descartes developed a better argument for his position than the simple dismissal from *The Meteors*. This, in turn, will allow us also to better assess the post-*Meditations* discussion on real accidents.

5.3 Descartes's nominalism

It is probably during his second stay in Holland, in 1628–1629, when the correspondence mentions a treatise on metaphysics, that Descartes thought more thoroughly about the ontological principles of his physics.³⁸ In October 1629, when he decided to explain 'all of the meteors', Descartes also said that he had now also 'decided' on 'the foundations of philosophy.'³⁹ This is the first record of this achievement, although, as we will argue, some of 'the foundations' are already in place in the *Rules*. *The World* and *The Meteors* appear as fruits of a project of 'explaining all the phenomena of nature' according to the new foundations.⁴⁰ The next spring, in May 1630, in one of the important letters on the eternal truths (a

³⁷ AT III 506.

³⁸ AT I 144.

³⁹ AT I 25.

⁴⁰ AT I 70.

key doctrine of the ‘foundations’), Descartes declared that he would explain clearly and definitively the soul of beasts ‘and the other forms and qualities’.⁴¹

The unpublished *World*, a project connected with that of the meteors, is much more vocal about the rejection of real accidents than the published essay. The text starts with arguing for the rejection of entities like forms, qualities, or motion as ‘different things’ in material bodies:

Others may, if they wish, imagine the form of fire, the quality of heat, and the process of burning to be completely different things in the wood. For my part, I am afraid of mistakenly supposing there is anything more in the wood than what I see must necessarily be in it, and so I am content to limit my conception to the motion of its parts.⁴²

The World will develop this polemical theme throughout the treatise. Discussing motion, Descartes reduces the three levels of the reality of accidents expressed in the School by the notions of *modes*, *modes with foundations in things* and *real qualities* to one category (modes). He even translates into French the scholastic terms:

The motion which I posit follows the same laws of nature as do generally all the dispositions and qualities found in matter—including those which the Schoolmen call *modos et entia rationis cum fundamentum in re* (‘conceptual modes and entities found in things’), as well as those they call *qualitates*

⁴¹ AT I 154.

⁴² CSM I 83 / AT XI 7.

reales (their ‘real qualities’, in which I confess frankly that I can find no more reality than in others).⁴³

Descartes also points out the consequence of this ontological reduction on scientific practice: since all modes can be explained further through motion and the configuration of particles, one could, in the end, even skip the level of qualities altogether in the explanation of natural effects:

If you find it strange that in explaining these elements I do not use the qualities called ‘heat’, ‘cold’, ‘moisture’ and ‘dryness’—as the philosophers do—I shall say to you that these qualities themselves seem to me to need explanation. Indeed, unless I am mistaken, not only these four qualities, but others as well, including even the forms of inanimate bodies, can be explained without the need to suppose anything in their matter other than the motion, size, shape, and arrangement of parts.⁴⁴

This kind of direct attack on scholastic notions will be heavily censored in the published *Meteors*. The only direct reference to the scholastic view is a statement at the end of the essay:

Know also that, in order to keep my peace with the philosophers, I have no desire to deny that which they imagine to be in bodies in addition to what I have given, such as their *substantial forms*, their *real qualities* and the like; but it seems

⁴³ CSM I 94 / AT XI 40.

⁴⁴ CSM I 89 / AT XI 25–6.

to me that my explanations ought to be approved all the more because I shall make them depend on fewer things.⁴⁵

However, not using real qualities amounts in itself to a rejection of them. Descartes will insist several times on the unintelligibility of the notion, which explains ‘that which is obscure through that which is more obscure,’⁴⁶ while continuing to say publicly that he is not refuting the scholastics ‘no more than if I had never known them.’⁴⁷

Although Descartes never offers a complete demonstration against real accidents, we can reconstruct *two* arguments on the basis of two basic Cartesian claims: (I) the reduction of the material substance to extension, the configuration of particles and their motion and (II) the thesis of the real distinction of the two substances. I believe that a distinction between these two claims is necessary for understanding Descartes’s thinking about real qualities. Argument I can stand without argument II and vice versa. One can be committed to a non-hylomorphic description of bodies (an atomist) without necessarily making any claim about the spiritual substance, or about its separation from matter. Conversely, one can be a dualist and subscribe to a hylomorphic description of material bodies.

Étienne Gilson and Daniel Garber have both insisted on the argument from the thesis of the real distinction of substances (II), which features prominently in the *Meditations* and the *Replies*. According to this argument, the scholastics introduce in physics entities that are thought of on the model of ‘little souls joined with their bodies’, by importing a concept from the thinking substance into the material substance.⁴⁸ Real accidents, forms and qualities, are a

⁴⁵ Olscamp 268 / AT VI 239. Same claim in AT II 200, AT III 492 and AT III 649.

⁴⁶ AT III 507, letter to Regius.

⁴⁷ AT VI 141.

⁴⁸ AT III 648. See also AT III 420. É. Gilson, ‘La critique cartésienne des formes substantielles’, in *Études*, pp. 143–68; D. Garber, *Descartes’s Metaphysical Physics* (Chicago: University of Chicago Press, 1992), chapter 4, and ‘Formes et qualités dans les Sixièmes Réponses’, in *Descartes. Objecter et répondre*, ed. by J.-M. Beyssade and J.-L.

product of the confusion between thought and extension, a pre-critical prejudice of our childhood from a time when ‘our mind was so immersed in the body that it knew nothing distinctly.’⁴⁹ Consequently, Descartes is taken to offer a critique of material hylomorphism only *after* he has completed the metaphysical deduction of the real distinction between the two substances in the *Meditations*. Gilson thought that the Aristotelian notion of nature was formed on the model of the idea of the soul, and that Descartes understood and critiqued this conception through the thesis of the real distinction of substances. I argue in what follows that Descartes’s critique of real accidents proceeds instead from a mechanical reduction of real accidents to modes of extension (argument I). While argument II (real distinction) is difficult to find in the corpus prior to the *Meditations* and the *Replies VI*,⁵⁰ argument I (nominalist reduction of accidents to extension as simple modes, on the basis of mechanical principles) offers the advantage of being a basic tenet of Descartes’s scientific project from its earliest manifestations.

An interesting objection to argument II was raised by Daniel Garber. Following Gilson, Garber also holds that Descartes thinks of substantial forms on the model of mental substance, as substances on their own. He also shows that argument II, the real distinction between substances, *by itself*, is not successful, needing a further step. Separating the thinking substance from the material substance does not preclude the fact that *some* thinking substances can be united with material substances, as it happens in the case of man, when the soul is joined with the body. Thus argument II will need the further step of a radical distinction between human bodies and the rest of material bodies: Descartes needs to say

Marion (Paris: Presses Universitaires de France, 1994), pp. 449–69; see also Michel Fichant’s comments on Garber in the same title, pp. 471–2.

⁴⁹ *Principia philosophiae*, I, 47, AT VIII 22, and I, 71, AT VIII 35. See also AT IV 114 (letter to Mesland, 2 May 1644): ‘Pour la difficulté d’apprendre les sciences, qui est en nous, et celle de nous représenter clairement les idées qui nous sont naturellement connues, elle vient des faux préjugés de notre enfance, et des autres causes de nos erreurs, que j’ai tâché d’expliquer assez au long en l’écrit que j’ai sous la presse.’

⁵⁰ Cf. M. Fichant, loc. cit., p. 478 and F. Alquié in Descartes, *Œuvres philosophiques*, (Paris: Bordas, 1963–1973), vol. 2, p. 882, note.

that the *only* incorporeal forms are the human minds, and that material bodies, as opposed to the human body, cannot be joined with incorporeal forms.⁵¹ I would add that, in this way, Argument II turns back to the nominalist reduction of the material substance to extension and the exclusion of other entities from matter. My purpose here, in re-examining the texts and disentangling Descartes's claims on hylomorphism, is to show that Descartes's commitment to nominalism (Argument I) is *the root* behind his critique of hylomorphism.

5.3.1 *Replies VI*

Argument II (real distinction) is developed extensively in *Replies VI*, where Descartes narrates a personal history on how he has arrived at the real distinction between body and soul. However, it is precisely in this text that Descartes also introduces argument I (reduction of accidents to modes of extension) as *a necessary step* in the very establishment of the real distinction between substances. The chain of reasons proceeds in the following steps (I summarize AT VII 440–1):⁵²

(1) The *Meditations* have established the real distinction between body and soul; Descartes was therefore compelled to assent to this metaphysical truth.⁵³

⁵¹ *Descartes's metaphysical physics*, ch. 4. I thank Daniel Garber for his clarifications on this point. The distinction between material bodies and the human body, to which Garber appeals to here, rejoins in an interesting way the analysis of J.-L. Marion, *Sur la pensée passive de Descartes* (Paris: Presses Universitaires de France, 2013), although Marion argues for a more radical distinction.

⁵² Cf. D. Garber, 'Formes et qualités dans les Sixièmes Réponses', for an alternative reconstruction of this passage.

⁵³ 'Cum primum ex rationibus in his Meditationibus expositis mentem humanam realiter a corpore distingui, et notioem esse quam corpus, et reliqua collegissem, cogebar quidem ad assensionem, quia nihil in ipsis non cohaerens, atque ex evidentibus principiis juxta Logicae regulas conclusum, advertebam.' (AT VII 440 1–6)

(2) However, he was not ‘entirely persuaded’ by it.⁵⁴

(3) Nevertheless, he continued to use the foundational principles established by the *Meditations* in his physics (‘rerum Physicarum’). The consideration of physical things implies an examination of the ideas and notions of things: one needs to submit the notions of things to proper distinctions so that they can be put in agreement with judgment.⁵⁵

(4) Through exercise (3), Descartes was brought to know that there is nothing in body but extension, motion and figure.⁵⁶

(5) The same exercise (3) brought him the knowledge that the sensible qualities of colours, smells, taste and the like do not have any existence outside of thought.⁵⁷

(6) The same exercise (3) brought him the knowledge that weight, solidity, the power of heating, attracting, purging and all other qualities can be reduced to motion or the privation of motion, and to the configuration of particles.⁵⁸

(7) Going back and considering why it is that he initially thought differently about these matters, Descartes realized that his false judgments were

⁵⁴ ‘Sed fateor me non idcirco fuisse plane persuasum, idemque fere contigisse quod Astronomis, qui, postquam Solem esse aliquoties Terra majorem rationibus evicerunt, non possunt tamen a se impetrare, dum in illum oculos convertunt, ut judicent non esse minorem.’ (AT VII 440 6–11).

⁵⁵ ‘Postquam autem ulterius perrexi, et iisdem innixus fundamentis ad rerum Physicarum considerationem transivi, primo attendendo ad ideas, sive notiones, quas de unaquaque re apud me inveniebam, et unas ab aliis diligenter distinguendo, ut judicia omnia mea cum ipsis consentirent . . .’ (AT 440 11–17).

⁵⁶ ‘ . . . adverti nihil plane ad rationem corporis pertinere, nisi tantum quod sit res longa, lata et profunda, variarum figurarum, variorumque motuum capax; ejusque figuras ac motus esse tantum modos, qui per nullam potentiam sine ipso possunt existere . . .’ (AT VII 440 17–21).

⁵⁷ ‘ . . . colores vero, odores, sapes, et talia, esse tantum sensus quosdam in cogitatione mea existentes, nec minus a corporibus differentes, quam dolor differt a figura et motu teli dolorem incutientis.’ (AT VII 440 21–5).

⁵⁸ ‘ . . . ac denique gravitatem, duritiem, vires calefaciendi, attrahendi, purgandi, aliasque omnes qualitates, quas in corporibus experimur, in solo motu motusve privatione, partiumque configuratione ac situ consistere.’ (AT VII 440 25–9).

caused by his ignorance of the distinction between extension and thought. This ignorance caused him to attribute intellectual things to corporeal things and vice versa.

This is the most elaborate argument against real accidents that Descartes ever gives. It proposes a tight reasoning that combines arguments (I) and (II) mentioned above. The account starts and ends in the real distinction of substances, thus justifying the support it offers to argument (II), while steps (3) to (6) develop the critique of real accidents on the basis that the various accidents of material bodies can be reduced to motion and the configuration of particles, i.e., argument (I). In this text, Descartes claims that the metaphysical deduction of the real distinction of substances, by itself, *is not enough*. In step (2), Descartes is not entirely convinced. It is only after step (3), after a consideration of the notions of extension and thought as applied in physics (i.e., as applied to material bodies as they exist in the world, as opposed to the abstract notion of body) that Descartes is persuaded of the real distinction between substances, and it is only in step (7) that the real distinction between substances can offer a full critique of real accidents. In other words, without the critical consideration of the notion of extension from step (3), Descartes would not have been fully persuaded by the real distinction of substances—just like an astronomer, he says, who still judges that the Sun is smaller than the Earth when he has it in front of his eyes, even though he knows through reason that it should be much bigger. Descartes needed the *a posteriori* demonstration of physics to fully assent to the metaphysical truth of the real distinction.⁵⁹ The critique of real accidents of the kind that argument (II) proposes, arriving at a ‘psycho-analysis of Aristotelian physics,’⁶⁰ is in this text *secondary* to argument (I), the nominalist reduction of material accidents to modes of extension.

⁵⁹ See the analysis of M. Fichant, ‘La « fable du monde » et la signification métaphysique de la science cartésienne’, in *Science et métaphysique dans Descartes et Leibniz* (Paris: Presses Universitaires de France, 1998), pp. 59–84.

⁶⁰ É. Gilson, *Études*, p. 168: ‘une psychologie de la physique aristotélicienne’.

We have established that the text from *Replies VI* uses argument (I) in order to arrive at the critique from argument (II). In a text from *Rule XIV* Descartes has developed more extensively steps (3) to (6), the consideration of the notions of things and the reduction of body to extension, in a more elaborated form.

5.3.2 *Rule XIV*

The relationship of the *Rules* with the publication of 1637 is complex and hard to grasp because of our lack of means for dating with precision the text and the stages of its elaboration.⁶¹ Nevertheless, this is of little concern for the present analysis. I take the argument from *Rule XIV* to be reflected in the text from the *Replies VI* analysed earlier, and thus to be a part of a sustained meditation on the critique of the reality of accidents. The argument may have evolved by the time that the *Replies VI* were written, but Descartes's anti-Aristotelianism never changed.

Rule XIV is part of the 'mathematical' part of the treatise (covering *Rules XIII–XXIV*, left unfinished), meant to treat perfectly conceived notions. In *Rule XIII*, Descartes abstracts the body from its material specificity, so that it can be 'geometrized' by reducing extension to figures. Abstraction is an operation of the intellect alone; as such, it cannot be used when considering physical matters. Therefore in the next rule, *Rule XIV*, Descartes appeals to the imagination as a faculty that allows us to assign a corporeal nature to the abstracted body, and thus make it physical. Imagination is the only faculty that can grasp a corporeal (extended) nature, because it is itself corporeal.

In this cognitive context, *Rule XIV* proposes a digression on an ontological question much discussed in the Schools: is there a reality of extension as distinct

⁶¹ The recent discovery of a new manuscript of the *Rules* at Cambridge could bring new elements. See, in the meanwhile, D. Garber 'Descartes and Experiment in the *Discourse* and *Essays*'.

from body?⁶² This question is introduced as an illustration for the proper use of imagination. To solve the issue, Descartes appeals to a test: if one can imagine extension without the body, then extension will be really distinct from body. Since this cannot be done, there will be no real distinction between extension and body. Those that think that extension can exist by itself without the body are not using a corporeal idea (their imagination), but a bad judgment (their intellect). It is a matter of using the right faculty for the right purpose:

Of course the learned often employ distinctions so subtle that they disperse the natural light, and they detect obscurities even in matters which are perfectly clear to peasants. So we must point out to such people that by the term ‘extension’ we do not mean here something distinct and separate from the subject itself, and that we generally do not recognize philosophical entities of the sort that are not genuinely imaginable. For although someone may convince himself that it is not self-contradictory for extension per se to exist all on its own even if everything extended in the universe were annihilated, he would not be employing a corporeal idea in conceiving this, but merely an incorrect judgment of the intellect alone.⁶³

Descartes continues the text with a complete critique of scholastic real accidents. Stating that he does not take extension as something separated from its subject (‘hic per extensionem non distinctum quid et ab ipso subjecto separatum designari’), he rejects all of the *entia philosophica* used by the philosophers (‘neque in universum nos agnoscere ejusmodi entia philosophica, quae revera sub

⁶² The digression starts at AT X 442.

⁶³ CSM I 59 / AT X 442.

imaginationem non cadunt'). The imperfection of the intellect (*intellectus male judicans*) supposes philosophical entities where there are none: real distinctions cannot be inferred on the basis of intellectual abstraction alone. Conscious of stepping into a field well-discussed in the schools, Descartes brings to the discussion the entire scholastic apparatus of the theory of distinctions to support his argument, in a technical analysis of common language (*extensio occupat locum=extensum occupat locum; corpus habet extensionem=extensio non est corpus*).⁶⁴ This analysis establishes that there can be no real distinction between the accident of extension and body, as most of the scholastics held, with the exception of the *nominales*. This digression from *Rule XIV* could stand very well in a scholastic disputation.

It is also remarkable that Descartes reverts completely to an Aristotelian-Thomist view of accidents in this text, as ontologically dependent on their subject. He quotes (perhaps unconsciously) Aristotle's definition of accidents as 'being in a subject' and being 'conceived' only together with a subject.⁶⁵ Later on, this cognitive argument, based on the proper use of the faculties of the soul, will become one of the most prominent features of Descartes's critique of hylomorphism. As Descartes explains to Regius in January 1642, substantial forms are just substances (souls), because they can be 'conceived' as stand-alone *res*; on the contrary, material forms cannot be 'conceived' as stand-alone *res*.⁶⁶

⁶⁴ See the analysis of J.-M. Beyssade, '« L'étendue n'est pas le corps » (*Regulae XIV*, AT X, 444, L. 18). Genres d'être et façons de parler dans les *Regulae*', *Laval théologique et philosophique* 53 (1997): pp. 755–66, reprinted in *Descartes au fil de l'ordre* (Paris: Presses Universitaires de France, 2001), pp. 88–104. On Descartes's theory of distinctions, see the letter from 1645–1646 at AT IV 348–50. On the importance of the late medieval theory of distinctions for early modern philosophy, see A. de Muralt, *L'enjeu de la philosophie médiévale* (Leiden, New York, Cologne: E.J. Brill, 1993), pp. 47–89.

⁶⁵ AT 444, 5–9, a direct quote from *Categories* 2, 1a 23–5. Cf. the comments of J.-L. Marion in his translation of Descartes, *Règles utiles et claires pour la direction de l'esprit en la recherche de la vérité* (The Hague: M. Nijhoff, 1977), p. 264ff.

⁶⁶ AT III 502.

The text from *The World* quoted earlier develops further this idea of a *test* for determining real distinctions in physical things. *The World* starts with a critique of the representational power of language in a chapter on ‘the difference between our sensations and the things that produce them’. Someone may imagine a form of fire, a quality of heat and an action of burning to be ‘completely different things in the wood’. But one can add or remove these entities without any effect for the process of burning; on the contrary, adding or removing the motion of the particles will actually decide whether the wood will burn or not:

For you may posit ‘fire’ and ‘heat’ in the wood, and make it burn as much as you please: but if you do not suppose in addition that some of its parts move apart and detach themselves from their neighbours, I cannot imagine it undergoing any alteration or change. On the other hand, if you take away the ‘fire’, take away the ‘heat’, and keep the wood from ‘burning’; then, provided only that you grant me there is some power which puts its finer parts into violent motion and separates them from the coarser parts, I consider that this power alone will be able to bring about all the same changes that we observe in the wood when it burns.⁶⁷

If the quality can explain an effect, it will be posited; if not, there is no reason to ‘conceive’ it. Descartes also reiterates here his idea that the reason behind positing a non-existent quality is a prejudice: it is a transmission of our sensation (heat) in the body in front of us. Argued for in this way, it will be clear that the thesis of the real distinction of substances (argument II) will help dispel that prejudice. *But this is not the argumentative move that Descartes presents first.* Here, the reasoning that concludes with the non-relevance of qualities starts

⁶⁷ CSM I 83 / AT XI 7.

from the consideration of natural effects, and goes through a process of trial and error, subtracting and adding explananda: motion explains things, qualities do not. *After* the trial and error decides that it is not the quality of heat or that of fire that produces the effect (alone), the critique of the prejudice through the distinction of substances can be set into place.

Conclusion

Texts prior to 1641, and especially the suppressed *World*, show that Descartes was engaged in a critique of real accidents very early, a commitment that he will downplay heavily when publishing *The Meteors*. But *The Meteors* themselves show this engagement in action, as an *a posteriori* proof of an unpublished principle. *Rule XIV* offers an elaborated argument against real accidents in nominalist terms. The argument from *Replies VI* also incorporates the line of thought started in *Rule XIV* as a necessary step in the establishment of the real distinction of substances.

The doctrinal development of real accidents has a rich history, reaching a turning point with Descartes. Late Aristotelian ontology, contrary to some seventeenth-century misrepresentations, is not a prolific pile of entities, but is quite careful in assigning the status of *res* to accidents.⁶⁸ Aristotelian textbooks of the early seventeenth century may present debates over what constitutes a real quality and what does not, but their complete rejection is unheard of. Meteorology is entirely based on the appeal to the four elemental qualities, the hot, the cold, the wet and the dry, understood as real qualities, and the scholastic course of physics is divided based on this notion. At the same time, authors that opposed Aristotelianism were willing to discard them. Isaac Beeckman, Descartes's early collaborator, held the view that hot and cold are explainable in terms of motion as

⁶⁸ Cf. R. Pasnau, *Metaphysical Themes*, pp. 197–8.

early as 1617.⁶⁹ The superfluity of substantial forms was publicly denounced in one of the theses proposed by Antoine de Villon and Étienne de Clave at the University of Paris in 1624, which stirred quite a scandal.⁷⁰ When looking at Descartes's numerous statements on real accidents in this context, one finds that from the beginning of his career he had been campaigning against them, more or less timidly, depending on audience.

The reduction of real accidents to modes, in itself, is not a new position in the metaphysics of substance. Descartes was radicalizing a tendency internal to Latin Aristotelianism. Descartes's anti-realism argues against the Scotist view of a univocal understanding of the 'being' of accidents and substances.⁷¹ Under a certain pressure from the nominalist current, a tendency in late Aristotelianism was to transfer those real qualities that are explainable by material configurations alone to the status of modes. Ockham's test for the reality of accidents had spared

⁶⁹ *Journal tenu par Isaac Beeckman de 1604 à 1634*, ed. by C. De Waard (La Haye: Martinus Nijhoff, 1939), vol. 1, p. 132.

⁷⁰ See the documentation published by D. Kahn, 'La condamnation des thèses d'Antoine de Villon et Etienne de Clave contre Aristote, Paracelse et les « cabalistes » (1624)', *Revue d'histoire des sciences* 55 (2002): pp. 143–98, second article in the text of the placard. On the early rejection of quality realism, see R. Pasnau, *Metaphysical Themes*, pp. 179–99. For the immediate context of Descartes, see D. Garber, 'Descartes, The Aristotelians, and The Revolution That Did Not Happen In 1637' and R. Ariew, *Descartes among the scholastics* and 'Descartes, Basson et la scolastique renaissante', in *Descartes et la Renaissance. Actes du colloque international de Tours des 22–24 mars 1996*, ed. by E. Faye (Paris: Honoré Champion, 1999), pp. 295–309.

⁷¹ For the passage from analogy to univocity of being in a historical perspective, see É. Gilson, *Jean Duns Scot. Introduction à ses positions fondamentales* and O. Boulnois, *Être et représentation. Une généalogie de la métaphysique à l'époque de Duns Scot* (Paris: Presses Universitaires de France, 1999), pp. 223–65 *passim*. For Descartes and Scotism, see R. Dalbiez's critique of Gilson: 'Les sources scolastiques de la théorie cartésienne de l'être objectif (à propos du Descartes de M. Gilson)', *Revue d'Histoire de la Philosophie* 3 (1929): pp. 464–72 and R. Ariew, 'Descartes and the Scotists' in *Descartes among the Scholastics*, pp. 71–100.

the elemental qualities as the last *entia philosophica* over and above extension.⁷² Historically, the kind of hylomorphic austerity that would lead to the reduction of the Aristotelian primary qualities, including the elemental ones, to modes, had not gone beyond Ockham. It does not appear the early Renaissance atomists had a sustained mediation on nominalism. If anything, with the spread of Scotism and the rejection of the *nominales*, seventeenth-century ontological thinking was inclined more towards quality realism than ever before. Aristotelian meteorology, for instance, as defined by the distinction between imperfect and perfect mixtures, could not survive without it.

Descartes's small essay on *The Meteors* of 1637 represents thus an engagement in a bigger battle. Although he censured himself heavily with respect to the reality of accidents in *The Meteors* (as *The World* shows), Descartes had the conceptual means to mount a frontal attack against it. He chose not to, and he hoped that the subversive implications of his physics would go unnoticed. In spite of the apparent innocence of the book, Schoolmen such as Fromondus saw in *The Meteors* a menace for their physics. When Fromondus received the Cartesian *Essays* in 1637, Descartes's explanations may not have seemed that revolutionary to him. There were other figures determined to ridicule the science of the Schools at the time and Fromondus knew them well. The inventiveness of Descartes's scientific narratives could not make up, in his eyes, for their fundamental heterodoxy. It is because of his rejection of real qualities that Fromondus accuses Descartes of atomism. It was not a light accusation; Dante had reserved a special place for people like him in the sixth circle of the inferno.

With these ontological decisions, Descartes changes radically the field of meteorology. This becomes apparent if we look at some of his earliest adherents,

⁷² *Summa logicae*, I, 55: 'For something is not made hot or cold through this alone and that the thing and its parts are moved locally. Hence all such qualities imply *res* distinct from the substance', apud R. Pasnau in *Metaphysical Themes*, p. 403.

Jacques du Roure, Jacques Rohault and Pierre-Sylvain Régis. The first generation of Cartesians, published complete books of Cartesian physics that followed more or less loosely the traditional order of topics inherited from Aristotelian manuals, and yet none of them included a treatise on the meteors as a distinct part of it. There is not much evidence that anyone was taken with *The Meteors*, and a lasting impact of any of Descartes's scientific ideas on particular meteors is hard to find. These authors follow Descartes's *Principles*, in which the meteors are not delimited ontologically from other types of bodies, but are treated just like any other physical bodies. They also take act of Descartes's rejection of the distinction between perfect and imperfect mixtures, each of them in different ways, while also propagating diverse scientific theories of the master on earthquakes, fountains or sea salt.⁷³

Jacques du Roure splits his *Physics* (1654) in two parts: a general part, which treats the notions we can apply to all bodies—the knowledge and existence of bodies, their principles, attributes and qualities, ending in a *De mundo*; and a second part, dealing with particular bodies. The subject of physics itself is changed according to the Cartesian doctrine: it is the science of all *corporeal things* that we can attain through reason, not the science of mobile body, because the notion of a corporeal thing can comprehend also non-corporeal things such as figure, motion or rest. The second part, devoted to the analysis of particular bodies, starts from simple bodies, the sky and the four elements, and then considers mixtures, bodies that are composed out of the four elements. Mixtures are divided into animated and non-animated. The non-animated mixtures are further divided into those that arise above us, namely the meteors, and those that are generated beneath us, such as stones, minerals and metals. Du Roure argues explicitly that it is wrong to identify the geographical division of mixed bodies with the ontological division of mixtures in perfect and imperfect, in the way in which the Aristotelians do:

⁷³ See P. Mouy, *Le développement de la physique cartésienne, 1646-1712* (Paris: J. Vrin, 1934).

Ceux qui appellent les Météores des corps imparfaits, ne prennent pas garde, ce me semble, que les Eaux, les Pierres et les Feux qui se forment dans les nuées, sont de même nature que les autres corps qu'ils nomment parfaits.⁷⁴

He also rejects the theory of the elements. They are simply the biggest bodies one can find in the sky, but they are not *perfectly* simple and they do not enter in the composition of all other bodies.⁷⁵ Du Roure consequently mounts an entire critique of the peripatetic doctrine of the elements and mixtures. (1) A first argument critiques the derivation of the four elements from different types of motion. Bodies, for the Peripatetics, can move only either upward, from the middle of the Earth towards its surface, like fire or air, or downward, from the surface towards the middle, like earth, or horizontally, like water. This violates the Cartesian principle that bodies do not move by themselves, but are moved by other bodies. It also presupposes that bodies move always in the same direction, which is not the case. (2) The Peripatetics also derive the existence of the four elements from that of the four qualities. But these qualities are themselves unknown, and there is no reason not to attribute other qualities to the elements. Moreover, the qualities are introduced externally; they are not a feature of the elements themselves. (3) The Peripatetics also demonstrate the presence of the elements in mixed bodies through their properties. The cohesion of bodies is due to water, their consistency is due to earth, their temperature to fire, and their fluidity to air. However, according to Cartesian physics, the cohesion and consistency of bodies is due to the fact that their parts are at rest, their heat or fluidity are due to motion, etc. With respect to mixtures, one needs to keep in

⁷⁴ J. du Roure, *La Philosophie divisée en toutes ses parties, établie sur des principes évidents*, t. II, *La Physique* (Paris: T. Jolly, 1654), p. 1–2.

⁷⁵ Ibid., p. 186: 'Ceux qui attribuent à ces corps le nom d'Éléments veulent dire qu'ils sont les plus grands et les plus remarquables corps que les cieux, dont nous venons de parler, contiennent ; mais ils ne veulent pas dire sans doute qu'ils soient parfaitement simples, ni qu'ils composent tous les autres corps.'

mind, according to du Roure, that the species of bodies are given by the size, motion and disposition of the parts. If the species were individuated only by a certain material composition (the elements), then mixture would be impossible, for it would presuppose a corruption of that material composition, and not an alteration. There is no retention of form for du Roure.

Jacques Rohault's *Traité de physique* (1671, with many subsequent editions), put in geometrical form, covers the meteors in its fourth part, titled *On terrestrial beings*.⁷⁶ Rohault has chapters on earth, air and water, but also on salt and oils, metals, minerals, magnets, before covering terrestrial meteors (subterranean fires, earthquakes), fountains, winds, rain, snow or hail, thunders and lightning, and ends with the rainbow. Meteorological topics that are relevant for the study of the celestial realm, such as tides, comets, the question of the height of the atmosphere, or of the distance between the Earth and the Moon, are moved in the third part of his physics, titled *Cosmography*. Rohault ignores completely the ontological notion of mixture and only mentions chemical mixtures.⁷⁷ *On terrestrial beings* develops a geographical presentation of topics with no regard for the division of the meteors according to the predominant element (aqueous, fiery, airy or earthly) that structured traditional books. In Rohault, we have the full replacement of the order of topics decided by the Aristotelian ontological division of bodies into more or less mixed with a geographical arrangement, which goes from celestial bodies down to atmospheric and terrestrial phenomena.

Pierre Sylvain Régis followed roughly the same order as Rohault in part V of his *Physics* (*Système de philosophie*, 1690).⁷⁸ Régis is however more attached to philosophical concepts. He explains the generation of mixtures ('corps qu'on appelle mixtes ou composées') within a Cartesian corpuscular cosmogony,

⁷⁶ J. Rohault, *Traité de physique* (Paris: chez la veuve de Ch. Savreux, 1671). The book had many editions in French, a few in Latin, and one in English. Samuel Clarke's annotated Latin translation was used as a teaching manual in England.

⁷⁷ J. Rohault, *Traité de physique*, p. 137.

⁷⁸ P.S. Régis, *Système de philosophie, contenant la logique, la métaphysique, la physique et la morale*, 7 vols. (Lyon: Anisson, Posuel & Rigaud, 1691), vol. 4.

taken from the fourth part of Descartes's *Principles*: water goes on to compose oceans, air composes the atmosphere, oil gives rise to fountains and salt gives rise to other minerals. But, contrary to Descartes, Régis also retains the distinction between perfect and imperfect mixtures:

Après avoir traité dans le Livre précédent des Mixtes qu'on nomme Parfaits, à cause qu'ils conservent longtemps leur Forme ; il nous reste maintenant à parler des Mixtes imparfaits qui durent peu, et qu'on nomme des Météores, parce qu'ils sont engendrés dans l'Air des Vapeurs et des Exhalaisons qui s'élèvent continuellement de la terre.⁷⁹

However, the fact that Régis retains a distinction between different types of mixtures does not necessarily commit him to the Aristotelian hyломorphic ontology that had sustained it. Although he speaks of the retention of form, Régis is merely rendering a difference between stable bodies and unstable bodies. There are no further ontological developments. The difference between elemental earth, situated towards the axis, and mixed earth, situated towards the surface, consists, for Régis, only in the degree in which the earth is rarefied by the motion of subtle matter.⁸⁰ Although not forgotten, by the 1690's the Aristotelian distinction between perfect and imperfect mixture had already become a vestige of a different age.

⁷⁹ Régis, *Système*, vol. 4, p. 79.

⁸⁰ Régis, *Système*, vol. 3, p. 230.

Part II. Hylomorphic composition in Descartes and Leibniz

6 Descartes and the Leuven affair

The following chapter presents the reactions to Descartes's account of the heartbeat expressed by the Leuven professors Fortunatus Plempius and Libertus Fromondus, reactions that also involved the Utrecht professor Henricus Regius. It clarifies certain aspects of the history of hylomorphism, without being directly related to the history of the theory of mixtures told in the previous chapters. I show here that the letters exchanged between Descartes and the two Leuven professors in 1637–1638 stirred a continuous debate, followed through a series of publications, up to the condemnations of Cartesianism in 1662–1663. I investigate the extent to which the reception of Descartes's account of the heartbeat contributed to the initial rejection of Cartesianism in Leuven and how physiological arguments were motivated by theological concerns throughout these exchanges. The heartbeat issue will appear as a special case of the wider problem concerning Descartes's mechanism as a whole and the resistance that Aristotelians opposed to it.¹

¹ This chapter was initially published as 'Descartes and the Heartbeat: The Leuven Affair,' *Perspectives on Science* 21 (2013): pp. 397–428.

6.1 The Leuven Affair

There is an interesting historical detour in the dissemination of one of the seventeenth century's most praised discoveries: the reception of Harvey's account of the circulation of the blood is closely intertwined, especially in the Low Countries, with Descartes's account of the origin of the heartbeat. Descartes was one of the first figures to support the circulation of the blood and to give credit to Harvey for it, although he presumably arrived at the same conclusion independently through his own anatomical experiments. He did so while vocally rejecting Harvey's views on the muscular nature of the heart and his explanation of cardiac motion, to promote his own mechanistic solutions instead. Although Descartes's mechanical physiology had been generally well received, particularly in the Northern Netherlands, and had quickly become a vehicle for Harvey's account of the circulation, this reception was not at all linear; it also generated controversy among the more theologically minded physicians.² I have set out to look here at a sustained exchange over Descartes's account of the heartbeat that

² Scholars tend to see that Descartes's account of the motion of the heart was more successful than that of Harvey. T. Fuchs, *The Mechanization of the Heart. Harvey and Descartes*, trans. by M. Grene (Rochester: The University of Rochester Press, 2001), p. 2: 'Harvey's discovery, as well as Harvey himself, was and is seen chiefly from a perspective that was determined to a great extent not by him, but by Descartes'. R. French, 'Harvey in Holland: Circulation and the Calvinists', in *The Medical Revolution Seventeenth Century*, ed. by Roger French and Andrew Wear (Cambridge: Cambridge University Press, 1989), pp. 46–87, p. 47: 'The doctrine of the circulation of the blood had its greatest impact in the Low Countries in conjunction with Cartesian mechanism.' M. Grene, 'Descartes and the Heart Beat: A Conservative Innovation', in *Wrong for the Right Reasons, Archimedes* 11 (2005), p. 93: 'as the idea of the circulation came to be accepted, it was in fact Descartes's view of the heart's motion that was, in many cases, accepted as the more persuasive account.'

had its epicentre in Leuven and that, I argue, is not disconnected from the events that led up to a famous series of condemnations of Cartesianism in 1662–1663. The events leading up to these condemnations are more complex and had multiple motivations, but I hope that the re-examination of the controversy generated by Descartes's account of the heartbeat will shed more light on the extent to which his physiology contributed to the initial reception (and rejection) of Cartesianism in the Southern Netherlands.

The history of the propagation of Harvey's medical discovery and its connection to Descartes has been explored in a number of works. Reception studies tell us how conservative or progressive these physiological ideas were on one side of the English Channel or the other. The greater success of Descartes's mechanism of the heart, as compared to Harvey's account, has been reported to parallel the success of mechanism vs. vitalism, with the complexities that this entails.³ More recently, Marjorie Grene has suggested that that Descartes's

³ See T. Fuchs, *The Mechanization of the Heart*, op. cit. Fuchs speaks of 'the vital aspect of the circulation' (Part C, 'Harvey') and of 'the mechanical aspect of the circulation' (Part D, 'Descartes and his followers'). The classic study of Etienne Gilson, 'Descartes, Harvey et la scolastique', in *Études*, pp. 191–245 is the first to have examined the issue in depth. E. Weil, 'The Echo of Harvey's *De Motu Cordis* (1628). 1628 to 1657', *Journal of the History of Medicine and Allied Sciences* 12 (1957): pp. 167–74 contains a useful list of early works referencing Harvey's *De Motu*. For more recent studies, see M. Grene, 'Descartes and the Heart Beat: A Conservative Innovation'; idem, 'The Heart and the Blood: Descartes, Plenum and Harvey', in *Essays on the Philosophy and Science of Rene Descartes*, ed. by S. Voss (Oxford: Oxford University Press, 1993), pp. 324–35; G. Gorham, 'Mind-Body Dualism and the Harvey-Descartes Controversy', *Journal for the History of Ideas* 55 (1994): pp. 211–34; P. Anstey, 'Descartes's cardiology and its reception in English physiology', in *Descartes's Natural Philosophy*, ed. by S. Gaukroger, J. Schuster, and J. Sutton (London and New York: Routledge, 2000), pp. 420–44; V. Aucante, 'Appendice 6' in Descartes, *Écrits physiologiques et médicaux* (Paris: Presses Universitaires de France, 2000), pp. 245–53; Roger French, 'Harvey in Holland: Circulation and the Calvinists', op. cit. For recent studies on Descartes's physiology in general, see A. Bitbol-Hespèries, *Le Principe de vie chez Descartes*, (Paris: J. Vrin, 1990) and V. Aucante, *La philosophie médicale de Descartes* (Paris: Presses Universitaires de France, 2006).

account of the heartbeat amounts to ‘a conservative innovation’, when compared to Harvey’s. That is, ‘his position proved more acceptable also because, in its medical details, it was more conservative.’⁴ This is one side of the story; Descartes’s physiological information and his scientific results may have been more traditional. But the philosophy behind it certainly was not, and perhaps this weighed more for his readers. It is true that Descartes retains a number of ‘conservative’ facts in his study of the heart, and most strikingly the Galenic thesis of the simultaneity of the systole and the diastole in the heart and the arteries. However, Descartes’s mechanical explanations and the conceptualization of the ‘fire without light’, which is the core of the Cartesian account, appeared to be unheard of. ‘Nova est ac inaudita, et prorsus absurda [opinio]’, cried a scandalized reader.⁵

My revision of the Leuven affair concentrates on the philosophical issues that determined the reception of the Cartesian account of cardiac motion. It supports the view that Descartes’s account of the heartbeat, given the philosophical and theological implications of its medical details, was to a great extent contrary to the medical tradition established in the university; that this tradition reacted strongly against it, largely on theological grounds; and that the same medical establishment preferred Harvey’s physiology as the more conservative one, against Descartes. The circulation of the blood is in itself metaphysically neutral; it can be taken to appeal both to an Aristotelian and an anti-Aristotelian. Descartes’s explanation of cardiac motion is not. The Leuven reception will show that Descartes’s account of the heartbeat was read and discussed not simply as a medical explanation, but as committing one to particular Cartesian theses on the nature and functioning of the soul, even before Descartes developed these theses in his later works, like the *Meditations* or the *Passions of the Soul*. I take it to be the case that by re-assessing the relatively

⁴ Preface to T. Fuchs, *The Mechanization of the Heart*, xiii. Grene developed this in her ‘Descartes and the Heart Beat: A Conservative Innovation.’

⁵ J. Riolan, *Opuscula Anatomica Nova* (London: 1649), p. 44, quoted by Gilson, *Études*, p. 96.

neglected importance of cardiac physiology as a vehicle for Descartes's larger natural-philosophical project, we will be in a better position to look at the aftermath of both these medical ideas within competing philosophical trends and of Cartesianism as a doctrine.

I start by briefly recalling the physiological matter at hand in Harvey and Descartes, and then examine the first reactions to Descartes's physiology of the heart from 1637–1644. In doing so, I follow a debate on the heartbeat between Descartes, Plempius and Regius, and I analyse it as motivated by commitments over the nature of the soul. In the third part I look at the theological reactions stirred by Descartes's account of the heartbeat from Fromondus and follow the development of Plempius's campaign against Cartesianism up to the 1662–1663 condemnations. Monchamp's *Histoire du cartésianisme en Belgique* (1886) remains an unrivalled source for the events leading up to the condemnations, which have not been examined extensively since. Armogathe and Carraud document the Leuven condemnations of Cartesianism of 1662–1663 through a presentation of the relevant texts, together with previously unedited ones. Ariew has brought forward a number of arguments related to the extension of the universe in the Leuven condemnations.⁶ The texts of 1662–1663 condemn, among other things, Descartes's physiology: the motivations and context of this historical detail will be examined here.

⁶ See J-R. Armogathe and V. Carraud, 'La première condamnation des *Œuvres* de Descartes, d'après des documents inédits aux Archives du Saint-Office', *Nouvelles de la République des Lettres* 2 (2001): pp. 103–37. G. Monchamp, *Histoire du cartésianisme en Belgique*, op. cit. R. Ariew, 'Quelques condamnations du cartésianisme: 1662–1706', *Bulletin cartésien XXII*, in *Archives de philosophie* 57 (1994): pp. 1–6 and *Descartes among the Scholastics*, pp. 241–67.

6.2 Descartes on the heartbeat

Evidence that Descartes read Harvey's *De Motu* appears in his correspondence in late 1632.⁷ For Harvey, the heart is an empty contracting muscle, which stirs the blood into motion by its beating and pushes it in and out.⁸ Descartes's expressed dissatisfaction with Harvey's account is that it does not explain the origin of the beating of the heart, so that we would need a 'pulsific faculty' to account for the beating.⁹ In Descartes's account, the bedrock of the

⁷ Gassendi read Harvey and wrote about it to Mersenne, who then asks Descartes what he thinks of it (AT I 264). Descartes responds in November or December 1632: 'J'ai vu le livre *De motu cordis* dont vous m'aviez autrefois parlé, et me suis trouvé un peu différent de son opinion, quoique je ne l'aie vu qu'après avoir achevé d'écrire de cette matière' (AT I 263). Descartes is taken to have written the *Treatise on Man* before reading Harvey. See Descartes to Mersenne, dated 1635-1636: 'An non nosti Londini celebrem quendam medicum nomine Hervaeum, qui librum de motu cordis et circulatione sanguinis conscripsit? quis homo est? Equidem de motu cordis nihil dicit, quod in aliis jam non extaret, neque illi per omnia assentior; sed quantum ad circulationem sanguinis, triumphat, ipsique honor debetur quod fuerit primus inventor, in quo Medicina ei multum debet.' (AT IV 699-700).

⁸ As a reminder, a central passage: 'First of all, the auricle contracts, and in the course of its contraction throws the blood . . . into the ventricle, which being filled, the heart raises itself straightway, makes all its fibres tense, contracts the ventricles, and performs a beat, by which beat it immediately sends the blood supplied to it by the auricle into the arteries'. (*The Works of William Harvey*, trans. Willis [Philadelphia: University of Pennsylvania Press, 1989], p. 31). For a good comparative account of the two theories of the heartbeat, see P. Anstey, 'Descartes's cardiology and its reception in English physiology', pp. 421-3.

⁹ Descartes is explicitly arguing against Harvey on several issues in the account from the *Description du corps humain*, AT IV 239-44. Cf. p. 243-44: 'Now supposing that the heart moves in the way that Harvey describes, not only must we imagine some faculty which causes the movement, the nature of which is much more difficult to conceive than what it is invoked

explanation is moved from a pulsific faculty of the muscle to the innate heat within the heart.¹⁰ While praising publicly Harvey on the matter of the circulation itself, Descartes maintained his own explanation of the heartbeat throughout his career, from the *Treatise of Man* (written in 1632), through the *Discourse*, in his correspondence and until as late as the *Description of the Human Body* (1647) and the *Passions of the Soul* (1649).¹¹ One can argue that Descartes's explanation was better at accommodating the corpuscularian physics that was gathering steam in the 1630's and 1640's. From Descartes's point of view, Harvey's account poses a problem of conceivability that can be addressed by Descartes's physics: how are we to 'conceive' a discrete motion of a muscle, as Harvey does, given that each local motion of a body is accounted for in terms of the communication of another local motion of a different body? Moreover, Descartes's thermogenic account also went along with the established medical knowledge in placing the vital heat within the heart and not in the blood itself.¹² It seemed like the perfect move for

to explain: we must also suppose the existence of yet other faculties that alter the qualities of the blood while it is in the heart'. (Trans. by Stephen Gaukroger in *Descartes, The World and Other Writings* [Cambridge: Cambridge University Press, 1998], p. 181. The passage in CSM I 318 is a little obscure). The 'pulsific faculty' was familiar from Galen, who used it to explain the motion of the arteries, as a faculty residing in the arterial walls.

¹⁰ For Descartes's mechanization of the idea of innate heat, see T.S. Hall, 'Descartes's Physiological Method: Position, Principles, Examples', *Journal of the History of Biology* 3 (1970): pp. 53–79, and A. Bitbol-Hespèries, *Le Principe de vie chez Descartes*, pp. 67–102.

¹¹ *Treatise on Man*: AT XI 123–7, *Discourse*: AT VI 46–55, *Description of the Human Body*: AT XI 228–45, *Passions of the Soul*: AT XI 331–4; Letter to Beverwijk, 5 July 1643, AT IV 3–6. Auguste Georges-Berthier's thesis that Descartes was not too concerned with the origin of the heartbeat in his early writings has been infirmed by Vincent Aucante (*Ecrits physiologiques et médicaux*, p. 245), who points out to two early fragments (AT XI 524). Aucante takes the first redaction of the *Description* to be immediately after the *Discourse* and to continue in 1638, which is consistent with the discussion from 1637–1638 that I am following (*ibid.*, p. 19).

¹² See M. Grene, 'Descartes and the Heart Beat: A Conservative Innovation', for details on this point.

Descartes: to explain new scientific facts through his physics while at the same time keeping the phenomenon in concert with the medical tradition.

The importance and degree of certainty that Descartes accords to his account of the heartbeat cannot be overemphasized. Descartes reiterates, every chance he gets, that his explanation of cardiac motion sits at the very core of his physiological endeavours. 'It is so important to know the true cause of the heart's movement that without such knowledge it is impossible to know anything which relates to the theory of medicine. For all the other functions of the animal are dependent on this', he states in the *Description of the Human Body* (AT XI 245 / CSM I 319). In the *Discourse* of 1637: 'Being the first and most widespread movement that we observe in animals, it [the motion of the heart and blood] will enable us to decide how we ought to think about all the others' (AT VI 46–7 / CSM I 134). The motion of the heart, giving rise to a circular motion of the particles of the blood, is the paradigm for explaining all bodily motions. Again, in the *Passions of the Soul*, the 'continuous heat of our heart' is said to be the 'corporeal principle' of all the motions of the body (AT XI 333). And at one point he speaks about his account in terms of its lying at the heart of his entire 'Plan of a Universal Science': 'I am prepared to admit that if what I have written on this topic [the cardiac cycle] or on refraction turns out to be false, then the rest of my philosophy is entirely worthless', he says to Mersenne in a letter of 1639 (AT II 501 / CSM III 134).¹³ Descartes's pronouncements in these passages suggest that the explanation of cardiac motion is not just one particular physiological account that can be discussed within the Cartesian system, and accepted or refuted; it is a key piece of the natural-philosophical project applied to the knowledge of the human body, and in turn validates that natural-philosophical project. That the explanation is closely linked to other fundamental tenets of the Cartesian program will appear clear to its very first readers.

With this in mind, I turn to the immediate reaction to his account of the heartbeat, coming from the briefly influential physician Fortunatus Plempius. The

¹³ AT VI 46–47 / CSM I 134. 'Projet d'une science universelle' is the projected title for the book of 1637, as per the letter to Mersenne of March 1636, AT I 339 / CSM III 51.

debate with Plempius is followed up through Descartes's disciple at the time, Henricus Regius and, in parallel, through a brief exchange with Libertus Fromondus. There are two main letters from Plempius and Descartes respectively discussing the physiology of the heart, all in a sustained correspondence of 1637–1638.¹⁴

6.3 Fortunatus Plempius (1601–1671) and Henricus Regius (1598–1679)

According to his own testimony, Plempius met Descartes somewhere in the early 1630's, while exercising his medical profession in Amsterdam, and kept in touch with Descartes through the second half of the 1630's, when he became professor of medicine at Leuven. In his colourful depiction, Plempius compared

¹⁴ Descartes sent Plempius three copies of the *Discourse* and *Essays*, out of which Plempius sent one to Fromondus and one to the Jesuit François Fournet (AT I 399). A letter from Fromondus to Plempius for Descartes, 13 September 1637 (AT I 402–9) sends a number of the theologian's objections on the book (see *infra*). Descartes responds to Fromondus's objections through Plempius in the letter of 3 October 1637 (AT I 413–31). Fromondus does not respond, but the discussion continues with Plempius: Descartes adds to Plempius some reflections on Fromondus's objections in a letter of 20 December 1637 (AT I 475–7) and asks from Plempius his comments on the motion of the heart. Plempius replies through a letter from January 1638 (AT I 497–9), advancing brief objections on both the motion of the heart and the circulation of the blood. Descartes replies at length letter from 15 February 1638 (AT I 521–34), to which Plempius replies in March (AT II 52–4) and obtains a second reply from Descartes on 23 March 1638 (AT II 62–9). A reply from Plempius from 20 April 1638 was lost. Descartes thinks about publishing the exchange (see the letter to Plempius from August 1638, AT II 343–5), but Plempius backs off, only to publish it himself. See also the new editions of Descartes's correspondence: *Tutte le lettere, 1619-1650*, ed. by G. Belgioioso (Milan: Bompiani, 2005) and *Œuvres complètes VIII. Correspondance*, ed. by J.-R. Armogathe (Paris: Gallimard, 2013).

their meeting to that of a Hippocrates meeting a Democritus.¹⁵ At the time, he was already a well-bred and mildly influential physician. Born in Amsterdam but educated in Catholic colleges and universities (Ghent, Leuven, Padoua, Bologna), he took up a chair in the faculty of medicine at Leuven in 1633, and he converted to Catholicism.¹⁶ He published his first medical manual, covering the first year of the medical *cursus* at Louvain, under the title *De Fundamentis Medicinae libri sex*, in 1638 (Leuven: Zegers). The *Fundamenta* is, in the words of one historian, ‘one of the most clear and complete works’ of seventeenth-century medicine.¹⁷ Plempius’s book appeared in 1638, a year after Descartes’s *Discourse*. He had most likely already finished writing it when he started his correspondence with Descartes, earlier in the same year, but he inserted some of the correspondence he had with Descartes. We do not have definite proof that Descartes knew of the preparation of Plempius’s book when their correspondence started, but given that he had known Plempius for a number of years before this, the odds are that he

¹⁵ Plempius testifies that he frequented Descartes in Amsterdam in the early 1630, while Descartes was living in a street of butchers to have easy access to dissection material. See his *Fundamenta medicinae* (Leuven: Zegers, 1654), p. 375 and AT I 401. Baillet, *Vie de Monsieur Descartes*, vol. 1 (Paris: D. Horthemels, 1691), p. 312, writes: ‘M. Descartes contait alors Plempius parmi l’un de ses meilleurs amis, et Plempius ne dissimulait à personne l’honneur et l’avantage qu’il croyait recevoir de cette amitié.’

¹⁶ On Plempius, see J.-P. Tricot, ‘Vopiscus Fortunatus Plempius’, in *Vesalius* 6 (2000): pp. 11–19; G. Monchamp, *Histoire du cartésianisme en Belgique*, *passim*. V. Aucante, ‘Les médecins et la médecine’, in *La biografia intellettuale di Descartes attraverso la Correspondance*, ed. by J.-R. Armogathe, G. Belgioioso, and C. Vinti (Naples: Vivarium, 1999), pp. 607–25; *The Correspondence of René Descartes: 1643*, ed. by T. Verbeek, E.-J. Bos, and J. van de Ven (Utrecht: The Leiden-Utrecht Institute for Philosophy, 2003), pp. 287–8. K. Vanagt, *De emancipatie van het oog: V.F. Plempius’s Ophtalmographia en de vroege moderne medische denkbeelden over het zien*, PhD thesis (Universiteit Twente, 2011). CSMK 389 wrongly gives 1661 as the year of Plempius’s death. For a general overview of philosophy at the University of Leuven during this time, see M. de Wulf, ‘Le Mouvement philosophique en Belgique (II)’, *Revue de néo-scholastique* 60 (1908): pp. 454–73 and G. Monchamp, *Histoire du cartésianisme en Belgique*, pp. 3–27.

¹⁷ J.-P. Tricot, ‘Vopiscus Fortunatus Plempius’, p. 14.

did. He certainly knew of Plempius's opposition to the theory of circulation, for he urged him several times to send him his objections.¹⁸

In the letter to Descartes of January 1638, Plempius brings forward three experimental objections against the circulation of the blood, all of which are refuted by Descartes, and four against Descartes's explanation of cardiac motion. The second letter, of March 1638, drops the discussion on the circulation while continuing that on cardiac motion.

Against the circulation of the blood, Plempius objects: that the arterial blood and the venous blood would have to be the same; that intermittent fevers, which are caused by localized matter (*materia febrilis*) in the veins, should travel along with the blood and cause many fever attacks instead of just a regular number per day; and that if one ligatures the veins of the leg of an animal while leaving the arteries free, the leg should swell considerably because of the incoming flow of blood, which does not happen.¹⁹ Descartes's answers on these matters are, arguably, convincing. First, he says, one could object to Harvey that his explanation does not account for the difference between arterial blood and venous blood, but not to him, who explains a transformation of the blood in the heart itself. The rarefaction of the blood in the heart makes the arterial blood brighter, and thinner.²⁰ For the second point, Descartes appeals to Fernel and his theory of

¹⁸ 5 October 1637: 'Quae de motu cordis muginari te scribis avidissime expecto' (AT I 411); 20 December 1637: 'Ideoque etiam tuas de motu cordis avide expecto' (AT I 477).

¹⁹ 'Contra sanguinis circulationem, quam cum Hervaeo adstruis, haec habeo: 1. Sanguis arteriosus et venosus sic plane similis esset, imo idem, quod repugnat autopsiae. Ille flavior et floridior, hic nigricantior et tristior est. 2. Materia febrilis consistens alibi in venulis a corde remotis, quaeque adeo febrem intermittentem tantum efficit, deberet plures de die accessiones facere, toties scilicet, quoties fit sanguinis illius et simul humoris febrilis reditus in cor; ponis autem reditum istum fieri centies, imo ducenties per diem. 3. In vivo animali ligatis venis plerisque ad crus tendentibus, liberis relictis arteriis, deberet crus illud brevi temporis spatio mirum in modum tumescere, eo quia sanguis continenter per arterias influeret per venas. Atqui tantum abest ut hoc fiat, ut potius, si diu sinas ligatas venas, pars extenuetur defectu nutrimenti.' (AT I 499).

²⁰ This argument is already given in the *Discourse*, AT I 52.

intermittent fevers, a good authority to bring in, and dismisses the objection as a side issue. The ligature experiment, he points out, is precisely one that shows the circulation, for if one would cut open one of the free arteries, the blood would flow more forcefully (AT I 531–4).²¹

Descartes's answers on the circulation were well received by Plempius: 'As to the others things that you bring forward in favour of the circulation of the blood, they are sound enough (*satis bene se habent*), and that opinion [of the circulation] does not really displease [me].'²² The exchange on the experimental evidence for the circulation of the blood seemed to end on Descartes's terms and Plempius did later become an advocate of Harvey. But the other matter raised in the correspondence, did not have the same outcome: when it comes to explaining the origin of the motion of the heart, Plempius was more resilient to Descartes's arguments. For Descartes, the two issues—the circulation of the blood and the motion of the heart—were inseparable. Not so for Plempius.

The discussion over the motion of the heart from the two letters (January and March 1638) is considerably lengthier. I will give only a brief summary. Plempius's comments are prefaced by a general remark, which is telling for his subsequent points: it is true that Aristotle talks about a certain heat in the heart, says Plempius, but 'our Galenus, contrary to this opinion, taught that the heart is moved by a certain faculty, and this is what all we medical men have been teaching up until now.'²³ Not only is he minimizing Descartes's contribution by reducing it to that of Aristotle, but also dismisses Aristotle's position as false according to Galen. In January, Plempius lays out a Galenist attack on the position that motion must be generated by a certain faculty, both in the heart and in the arterial walls. He offers a famous Galenic experiment with ligatures,

²¹ I refer to Grene, 'The Heart and the Blood: Descartes, Plemp and Harvey', for more details on these arguments. I am concerned here more with the discussion on the origin of motion in the heartbeat.

²² 'Caetera quae dicis pro circulatione sanguinis, satis bene se habent, neque ea sententia valde displicet.' (AT II 54). For Aristotle, see *De Respiratione*, 20, 480a.

²³ 'Galenus noster contra a facultate aliqua cor moveri docuit, et omnes hactenus id docemus Medici, a quibus quod adhuc stem hae faciunt ratiunculae.' (AT I 497).

intended to show that the arteries pulsate in virtue of something flowing through the arterial walls, not in virtue of the flow of the blood through them. Descartes proves the experiment wrong according to ‘the laws of my mechanics.’²⁴ Next, Plempius questions Descartes’s ‘mechanics’ itself: the process of fermentation through which Descartes explains the rarefaction of the blood is a much slower process in nature than what we would need for the heartbeat. Rarefaction is gradual. Descartes answers to this at length and brings in an analogy with certain fluids, which, once they have reached a certain degree of heat, burst out of the pot, very quickly. He does not go so far as to reproduce experimentally the rarefaction of the blood though. Next, Plempius serves another objection from mechanics: the communication of motion from the heart to the arteries would not be transmitted throughout the body instantaneously, which would account for the simultaneous pulse of the vessels, but only to the neighbouring arteries. Descartes refers back to his anti-Galenic experiments for this: the blood pushed through the arteries neighbouring the heart would in turn push out the rest of the blood. According to Descartes, the communication of motion through the body is without loss.

The details of these arguments are important for the experimental exposition of Descartes’s account, one of the best he ever gave, and they have been justly exploited by the literature.²⁵ But I would like to call attention to one point detailing the instantaneous rarefaction. According to Plempius, a heart freshly extracted from a living body continues to beat. How is this possible for Descartes, if the blood is no longer there to entertain fermentation? Descartes gave several experimental answers to this: that there always remains some blood, as he had seen in his observation on fish, developed his theory of instantaneous rarefaction and that of the yeast that remains in the extracted heart to entertain fermentation. The interesting bit however is that Descartes uses Plempius’s own observation against him, as an argument against the motor force of the sensitive soul: the soul is in fact not supposed to remain and act in a dead heart.

²⁴ The experiment is a common place for early modern Galenists. See Grene, ‘The Heart and the blood’, pp. 327–8, for a report on it.

²⁵ See Gilson, ‘Descartes, Harvey et la scolastique’, and Grene, ‘The Heart and the Blood’.

This objection seems to me much more damaging to the view, which is commonly held by others, that the movement of the heart is due to some faculty of the soul. For how, I ask, can the movement which occurs in the cut-up bits of the heart depend on the human soul, when it is taken as an article of faith that the rational soul is indivisible, and has no sensitive or vegetative soul attached to it?²⁶

This point marks a shift in the argument from scientific (experimental) evidence to broader concerns. The objection forces Plempius to reply, in his second letter, that even if the soul goes away, its ‘power’, some of the soul’s faculty or ‘instrument’, lingers:

I think nevertheless that one can save the common opinion [of the faculties of the soul]: even though the soul in a human heart extracted from a living body is no more, and consequently neither the faculty, there remains however for a certain time the instrument of the soul, i.e., the spirit which acts in virtue of the soul. Thus I retain that in the corpse of a freshly beheaded man contractions, digestions and assimilation of food take place, just as in a living man, for as long as the heat and the vivifying spirit remain in it.²⁷

²⁶ AT I 523 / CSMK 80–1.

²⁷ ‘Nihilominus ego vulgarem opinionem salvam facere mihi posse videor; nam etsi in corde humano exempto anima non sit, nec consequenter etiam facultas, instrumentum tamen animae illi aliquantisper inest, spiritus scilicet in virtute animae agens. Sic existimo in cadavere hominis subito decollati fieri attractiones et coctiones et assimilationes alimenti perinde uti in vivente, quandiu calor et spiritus vivificus cadaveri inest.’ (AT II 53).

The separation between the motor function or instrument of the soul and the soul itself plays right into Descartes's hand. Ontologically, this entails that a quality or power of a substance remains while the substance is gone. Descartes's reply is unforgiving, in a change of tone uncharacteristic for what was until now a courteous exchange:

In order to explain how a human heart cut from a corpse can move when the soul is no longer present, you resort to the idea that heat and vital spirits cause the movement by operating as instruments of the soul. Now is this not resorting to desperate measures? For if these instruments should sometimes suffice on their own to bring about this effect, why not always? And why should you imagine that when the soul is absent, these effects should occur through some power of the soul, when you think that no such power is needed to bring them about when the soul is present?²⁸

In a rare moment of open attack on Aristotelianism, Descartes compared Plempius's objections with that of army captains who want to defend themselves with poor ammunition, and fire everything they have rather than capitulate.²⁹

²⁸ AT II 65 / CSMK 94.

²⁹ 'Verum imitari vis egregios illos belli duces, qui cum arcem aliquam, quae male munita est, servandam susceperunt, licet obsidentibus resistere se non posse agnoscant, non tamen ideo protinus ijs se dedunt, sed malunt omnia prius tela consumere, et extrema quaeque experiri: unde fit, ut saepe, dum vincuntur, plus gloriae quam ipsi victores reportent.' (AT II 64–5). Descartes was receiving at the same time the same line of argument from Fromondus, see *infra*. This may have prompted his rebuttal of Plempius, and the use of plural can be read as addressed toward both Fromondus and Plempius.

The exchange ended here, although Plempius sent another reply, now lost. As mentioned, Plempius quoted and reported arguments from Descartes's letters in his *Fundamenta Medicinae* later in the year (1638). Descartes also entertained the idea of publishing the exchange, but meanwhile these letters circulated widely. Descartes's physiology, before the publication of the *Passions of the Soul* and the *Treatise on Man*, is known to the learned world through the *Discourse* and through the letters to Plempius.³⁰

The second edition of Plempius's *Fundamenta medicinae*, of 1644, marked Plempius's conversion to Harveyan circulation. After presenting an interesting story of his troubles with the theory, he admitted bluntly that, although he did not like this novelty at first, having been trying to refute Harvey's 'praiseworthy arguments', he realized that he came to refute himself. And then he set out to probe them through his own vivisections of dogs, which finally forced him to admit the circulation of the blood.³¹ It is a resonant conversion for the

³⁰ Years later, in 1643, a Dutch physician, Johan van Beverwijck (Beverovicus, 1594–1647), shows an interest in this exchange and asks from Descartes his letter to Plempius regarding the circulation of the blood, alluring Descartes with the intention of publishing it in a *Recueil* of letters of 'important men'. Descartes sends him the entire dossier: the two letters from Plempius and his response letter together with the minutes he had taken of their encounter. Van Beverwijck indeed publishes them in his edition of *Epistolicae Quaestiones* (Rotterdam: Leers, 1644; see a translation of the letters, as published by Van Beverwijck, by L.A. Post, in G.A. Lindeboom, *Descartes and Medicine* [Amsterdam: Rodopi, 1979], pp. 104–22). Later on, Princess Elisabeth of Bohemia shows knowledge of the exchange in her letter to Descartes of May 24, 1645 (AT IV 210). Harvey himself recognises the importance of Descartes's version of the circulation in his second letter to Jean Riolan of 1649, and the English edition of the *De Motu Cordis* cites, in De Back's appendix, Descartes's experiment of the vivisected beating heart of the eel from his correspondence with Plempius (*The Anatomical Exercises of Dr. William Harvey*, [London: F. Leach, 1653], p. 118). See also AT I 508, 515, 651–2. AT IV 180 finds reference to the Plempius letters in the *Admiranda methodus* of Martin Schook, a book belonging to the debate between Descartes and Voetius.

³¹ 'Primum mihi inventum hoc non placuit, quod et voce et scripto publice testatus sum, sed dum postea ei refutando et explodendo vehementius incumbo, refutor ipse et explodor; adeo sunt rationes ejus non persuadentes, sed cogentes: diligenter omnes examinavi, et in vivis

medical world.³² He also published here, for the reader to judge for himself, Descartes's letters to him in their entirety.

Although Plempius cites only Harvey as having convinced him, the context of the heated discussion with Descartes during this time should have played a significant role in his making up his mind.³³ This has led most commentators to conclude that it is the exchange with Descartes that convinced Plempius accept to the theory of the circulation. As proof of this, commentators send to Plempius's letter to Descartes from March 1638, where Plempius shows himself satisfied with the answers to his objections that Descartes had provided.³⁴ The basis for this assessment is too thin in my opinion to be conclusive.³⁵

Firstly, the phrasing of Plempius in the March 1638 remark, 'neque ea sententia *valde* displicet', suggests to me that his opposition to the circulation of

aliquot canibus eum in finem a me diffectis verissimas comperi.' (*Fundamenta medicinae*, 1644, p. 115a).

³² See *The Anatomical exercises of Dr. William Harvey*, Wood's preface, p. 12, on Plempius's conversion: 'Here's a great change in his judgement. Hence I begin to hope for equity in others, that laying aside all hatred, and acknowledging their error, they will at last with Plempius begin to think well of Harvey.' Wood quotes the entire passage from Plempius (p. 11–12).

³³ Ibid. On Walaëus's experiments with ligatures confirming Harvey (1641), see W. Pagel, *New Light on William Harvey* (Basel: S. Karger, 1976), pp. 113–35. Plempius, a Dutchman, probably made Walaëus's acquaintance while in Leiden or in Amsterdam in the early 1630's.

³⁴ T. Fuchs, *The Mechanization of the Heart*, p. 129: 'In fact, Descartes was able to persuade Plemp to accept Harvey's doctrine of the circulation.' M. Grene, 'Translator's Forward' to *The Mechanization of the Heart*, p. xii: 'Indeed, Plemp, who had raised numerous objections to the notion of the circulation, was converted, presumably by Descartes's arguments (and observations!)'. G. Gorham, 'Mind-Body Dualism and the Harvey-Descartes Controversy', p. 216, n. 22: 'Descartes eventually manages to convert Plempius on the circulation hypothesis.'

³⁵ I am in agreement with French, 'Harvey in Holland. Circulation and the Calvinists', p. 79, who derives from extrinsic arguments (the medical tradition to which Plempius was faithful) that Plempius 'has been won over by Harvey, not by Descartes'. My view is somewhat stronger than French's: it is the confrontation with Descartes that pushes Plempius to embrace Harvey, via the heartbeat issue, as a way to counter a perceived materialism in Descartes.

the blood at that time was not so strong to begin with. Plempius has a schoolman's mind. The objections he brings against the circulation, after hesitating to do so at Descartes's invitation, should be taken in a scholastic context, where exposing objections does not necessarily entail an assent to those objections. This is confirmed by his retraction when Descartes proposes to publish the exchange: Plempius agrees to the publication, but he asks Descartes to leave out his objections concerning the circulation. Descartes, reluctant to do so, proposes to insert a mention that would say that those objections were made 'animi gratia' and only in order to satisfy Descartes's request, and not because Plempius thought them to be true.³⁶ The same factor should be taken into account when assessing the published textbook. Secondly, in his public confession from 1644, while publishing Descartes's letters in their entirety, Plempius does not rest his change of mind on Descartes's arguments against his objections. He never mentions Descartes as having convinced him in any way, although he certainly had the opportunity to do so. Nor do his contemporaries read him as someone who had been influenced by Descartes on the matter. Jean Riolan, when presenting Plempius's account of the circulation right after that of Descartes, does not send back to Descartes, but invokes Plempius's experiments, 'quae sunt ab Harveo et Vallaeo proposita et observata'.³⁷ The section on circulation from Plempius's *Fundamenta* of 1644 contains no trace of Descartes (pp. 115–18). He quotes (1) Harvey; (2) Johannes Walaeus, who published his experimental results confirming Harvey in 1640, and whom he knew from Leiden; (3) his own scholastic exercises trying to refute Harvey, in writing and in the classroom; and (4) his vivisections. The exchange with Descartes contributes to (3). It is one of the factors in a more complex process. Between the exchange with Descartes over

³⁶ 'Quantum vero ad eas, quae spectant circulationem sanguinis, quas velles me omittere, faciam omnino in hoc prout tibi visum fuerit; verum certe illas pluris facio, quam tu, et merito possum inter validissimas, quas acceperim, reponere; quapropter si velles, malletm nihil immutari; nisi si verba quaedam hic illic, prout erit in rem, inserantur, quibus profitearis te animi gratia, aut a me rogatum illas proponere, potius quam quod illas veras existimes.' (AT II 344). This is a reply to a lost letter from Plempius.

³⁷ J. Riolan, *Opuscula Anatomica Nova*, p. 45.

the circulation and the public conversion in the *Fundamenta* of 1644, Plempius nevertheless published the first edition of the *Fundamenta* in 1638, where he continued to doubt Harvey. Granted, the circulation of the blood and Harvey's contribution had gained a lot more exposure by 1644 than they had in 1638, and perhaps Plempius, as a newly minted professor, could not allow himself to approve of the doctrine in 1638 but could do so in 1644. In 1638, Plempius told Descartes that 'this opinion does not really displease me', that he had only made those objections 'animi gratia', while at the same arguing against the opinion in his book. There is no other exchange between him and Descartes from 1638 to 1644, so that no other arguments for the circulation are brought forward from Descartes's side. Moreover, when Plempius decided to publish Descartes's letters in 1638, he chose to leave out precisely his arguments for the circulation of the blood. If Plempius revised his opinion in 1644 while meditating on Descartes's arguments from 1638, which he decided to leave out in the *Fundamenta* 1638, there is no trace of this in his writings. Descartes's arguments for the circulation of the blood may very well have contributed to Plempius's conversion, together with other factors, but they can hardly be seen as the decisive factor.

Whatever the reasons behind the conversion, it is the way in which Plempius presented it that mattered, and he gave the entire credit to Harvey. Plempius chose to publish Descartes's letters in 1638 truncated. He only retained the arguments concerning the origin of the motion of the heart, and left out completely the arguments concerning circulation itself. What interested him in 1638 in this exchange with Descartes was not the circulation, but the motion of the heart. The second edition of the *Fundamenta medicinae* (1644) displays an extensive attack against Descartes's account of the motion of the heart in favour of a Galenic 'pulsific faculty'. The fifth chapter of the second book is devoted to the 'vital faculty' and is subtitled: 'the motion of the heart is caused by the pulsific faculty, not by the fermentation of the heart, against Aristotle and Descartes.'³⁸ In

³⁸ 'Quid facultas vitalis. Est duplex: utraque dici potest naturalis facultas. Motus cordis sit a facultate pulsifica, non a fervore sanguinis, contra Aristotelem et Cartesium. Harvei sententia vera de motu arteriarum. Facultas pulsifica duplex in corde' (*Fundamenta medicinae*, 1644,

addition to reporting the arguments from the letters, Plempius clarified his position against Descartes in important ways. His new argument here is the following. There are two separate contrary motions in the heart: a contracting and a distending motion. This would call for a redoubling of the pulsific faculty: a contracting faculty and a distending faculty. He admits though that there can be no distending faculty, since the dilation of the heart can be explained through the influx of the blood, as per Harvey's demonstrated circulation. It remains nevertheless to explain the contracting faculty: rejecting the Cartesian 'vaporization' of the blood, Plempius can still hold that for the systole one needs to pose a pulsific faculty, like the one we have in the muscles (p. 160).³⁹ Thus the motion of the heart is entertained by this pulsific faculty, contracting and releasing the cardiac muscle.

Plempius correctly identified both Harvey and Descartes as adversaries of the Galenic 'pulsific faculty' (p. 150). But he chose to argue at length against Descartes, not against Harvey, and his argument drew heavily from Harvey's analysis of the systole. Harvey showed how the heart works rather by contracting than by dilating the chambers, and how the violence of the blood's exit is the main driving force of the circulation. Plempius's argument, at face value, weighs against the rhythmical pulsific faculty of the Galenists just as much as that of Harvey: there is no rhythmic dilation and contraction due to a pulsific faculty, but there is contraction. What he adds to Harvey is a proper cause for the contraction, one which Descartes himself had identified with a 'pulsific faculty' when reading

150b). For the pulsific faculty (which causes the muscle of the heart to move simultaneously with the motion of the arteries), see Galen, *De usu partium*, lib. VI, cap. XVII.

³⁹ See Harvey's text from *De motu cordis*: 'From these particulars it appears evident to me that the motion of the heart consists in a certain universal tension—both contraction in the line of its fibres, and constriction in every sense. It becomes erect, hard, and of diminished size during its action; the motion is plainly of the same nature as that of the muscles when they contract in the line of their sinews and fibres.' Trans. Willis in *The Works of William Harvey*, p. 22. See also his ontological speak in a later letter to Morison, 28 April 1653: 'Now these two motions [systole and diastole] inhere in the substance of the heart itself, just as they do in all other muscles.' (*The Works of William Harvey*, p. 604).

Harvey. For Plempius, Harvey is the *via media*. Just as Descartes had read the pulsific faculty in Harvey's forceful systole, Plempius effectively uses the same reading as a way to counter Descartes. His conversion to Harvey in 1644 enhances his position against Descartes on the matter of the heartbeat, which can be seen as yet another motive behind his choice for Harvey's version of the circulation.

A second historical detail of the 1644 publication of the *Fundamenta* is telling for the follow up of the exchange. The precise instrumental cause for which Plempius published Descartes's letters here was that he was summoned to do so by one of Descartes's disciples at that time: Henricus Regius. The second publication of the letters was not meant to support his conversion as coming out of the exchange with Descartes, as one would have thought: he only published the exchange again as an answer to Regius's interpellation.

Descartes was left in August 1638 with no reply from Plempius concerning the plans for the publication of the exchange. He did not learn of the publication of extracts of his letters in the 1638 *Fundamenta* until later in the spring of 1640, when Henricus Regius, at the time Descartes's close disciple and early promoter of Cartesianism in the Northern Netherlands, sent him a letter informing him of the matter. The letter is now lost but, according to Baillet, Regius reported on the matter in terms one could not reproduce.⁴⁰ Not only so, but Regius set out to hold in Utrecht a disputation on the circulation of the blood defending Descartes's account of the heartbeat. Before sustaining the disputation, Regius sent his theses to Descartes for approval, and Descartes made comments on each of them (see AT

⁴⁰ Monchamp *Histoire du cartésianisme en Belgique*, p. 137, states wrongly (and uncharacteristically for his usual accuracy) that Regius wrote the letter to Plempius, citing Baillet. Baillet, *Vie de M. Descartes*, vol. 2, pp. 36–7 is explicit on the fact that Regius wrote to Descartes, not to Plempius: 'M. Regius fut outré d'une conduite si malhonnête, et ayant confronté son livre avec les réponses que M. Descartes avait faites près de deux ans auparavant à ses objections, il ne put retenir l'indignation qui lui fit prendre la plume pour en marquer ses ressentiments à M. Descartes. Les couleurs qu'il donne dans sa lettre à l'ingratitude et à la mauvaise foi de M. Plempius sont si vives, qu'on ne peut les exprimer de sa langue en la nôtre sans entrer dans de semblables transports de colère contre une conduite si lâche.'

III 726). The disputation took place on 10 June 1640, through one of Regius's students, Johannes Hayman. In the text of the printed theses, Regius reported Plempius's dishonest publication of 1638 of Descartes's letters to him in harsh terms.⁴¹

Regius's disputation gave Descartes's account of the motion of the heart almost exactly as per the *Discourse* (these III, AT III 728–9). It also quoted a passage from Aristotle's *De Respiratione*, 20, about the heart's pulse as an ebullition, to support Descartes's account (AT III 730). This is the same passage quoted by Plempius in his first letter to Descartes on the circulation (AT I 497). In a clever re-appropriation, Regius took up the passage, with Descartes's approval, from Plempius, as a support for the Cartesian account of the heartbeat. Next, in thesis VII, Regius held a paragraph vilifying Plempius's publication of Descartes's letters: 'He partly mutilated and perverted the responses at objections and instances, and he omitted some. Such that whoever will compare his account with the letters written two years before this publication, will be able to tell.'⁴² Descartes had instructed Regius to put his French name, 'Descartes', instead of the Latin Cartesius, and had asked him to temper his adjectives and to give examples of the mutilation (AT III 68). Regius did not conform to the recommendation.

⁴¹ *Disputatio medico-physiologica pro sanguinis circulatione . . . sub praeside D. Henrici De Roy . . . Exercitii gratia, Publice defendere conabitur Iohannes Haymannus . . . ad diem 10. Iunii* (Utrecht: 1640). The text is reprinted in AT III 727–34.

⁴² 'Hanc verissimam Viri Nobilissimi et Incomparabilis D. Renati des Cartes sententiam nuper litteris familiaribus labefactare conatus est Plempius in *Lovanensi Academia Medicinae Professor*. Quamvis autem sollidissime ad argumenta, quae proposuit, ipsi sit responsum, et plus quam satisfactum: placuit tamen ipsi rem privatim actam, inscio Renato, publicam facere Doctorumque circulo arbitrandam subicere. Ut itaque Disputationis hujus Moderator etiam suum hic interponat arbitrium, videtur *non tantum per compendium (ut ipse ait), sed cum veritatis dispensio, nec satis bona fide, res ab ipso*, in libro quem *Medicinae Fundamenta* appellat, *fuisse enarrata*: Responsiones enim ad objectiones et instantias, *partim mutilaverit et pervertit*, partim artificio quodam praeteriit.' (AT III 732, emphasis added).

This disputation is quoted by Plempius in the *Fundamenta* of 1644 when publishing anew Descartes's letters, this time unabridged. His gesture here is an answer to the Descartes-Regius attack from the disputation of 1640.⁴³ It is therefore through Regius that the dispute with Descartes continued in 1644, and Plempius answered to this renewed attack from Descartes's side. Regius's involvement and Plempius's 1644 edition makes explicit the shift of the dispute from the issue of the circulation of the blood to the more theologically informed issue of the cause of the heartbeat. What started in 1638 as a dispute over the theory of the circulation of the blood became by 1644 a dispute over the status over the powers of the soul. The *Fundamenta* (1644) continued to defend the positions on the functions of the soul expressed by Plempius in his 1638 letters and expanded on them. In the letters, Plempius had given a vivid idea of how the life-responsible 'faculty' of the soul operates (a 'vivifying spirit'): one can see it in freshly extracted hearts, or in freshly beheaded bodies, which continue to function and even digest food in virtue of the soul's lingering 'spirit'. The *Fundamenta* of 1644 presents the same 'facultas vitalis' as a faculty of the soul. It is in fact now *duplex*: *vivificatrix*, which produces the vital spirits, and *pulsifica*, which entertains the motion of the heart by provoking the systole (*Fundamenta* 1644, p. 150). At the same time, he did not shy away from acquiescing to Harvey's mechanical explanation of the motion of the arteries (p. 160) and to his explanation of the diastole. It is not mechanism by itself that Plempius resists, but precisely the rejection of the 'pulsific' faculty as a source of motion. As he told

⁴³ 'Quod non tantum per compendium (ut ego ais) sed cum veritatis dispensio, nec satis bona fidem responsiones ennaraverim, ac partis eas mutilaverim et perverterim, partim artificio quodam praeterierim'. (*Fundamenta medicinae*, 1644, p. 152a, emphasis in the original). This is a direct quote from Regius's disputation quoted in the previous note (AT III 732). See also Descartes to Berwerwijk, 5 July 1653, in which Descartes complains again about Plempius, in the same terms: 'Sed nonnullae objectiones, ad ipsam pertinentes, mihi missae sunt Lovanio ante sex annos, ad quas tunc temporis respondi, et quia earum auctor meas responsiones *mala fide distortas et mutilatas* in lucem edidit.' (AT IV 6, my emphasis).

Descartes in 1638, both of them carry amphorae impregnated with different odours.⁴⁴ The 1644 publication is an anti-Cartesian treatise.

Descartes's use of Regius in the debate warrants more consideration for the history of the reception of his account of the heartbeat, because Regius did not always conduct himself as docilely as in this attack. Through his reactions to Plempius and his sustained series of publications radiating from the northern Netherlands, he can be seen as a catalyser for the precipitation of the Leuven affair, precisely because of his growing heterodoxy with respect to the medical establishment while professing Cartesianism. From proposing a radicalized version of Descartes's physiology in the 1640's and giving a summa of Cartesianism that Descartes never wrote (*Fundamenta physices*, 1646, with enlarged editions in 1653 and 1661) Regius would evolve to depart from Descartes and eventually oppose him with an alternative account of the motion of the heart.

Already in the lost letter reported by Baillet, of 1640, Regius is reported to have questioned Plempius's understanding of the Cartesian account of the cause of the heartbeat: 'Where Mr Descartes reports multiple causes which, taken together, produce the heartbeat, Plempius only retains one of them, namely heat.'⁴⁵ This phrase testifies for the fidelity of Baillet's report on the letter, as indeed Regius will continue in his publications to report a number of 'secondary causes' for the heartbeat.⁴⁶

⁴⁴ 'Sed tamen aliter sentimus, quia dum testae recentes eramus, alio odore imbuti fuimus, quem servamus.' (AT I 400).

⁴⁵ 'Qu'à l'endroit où M. Descartes rapporte plusieurs causes qui jointes ensemble produisent le battement du cœur, Plempius n'en rapporte qu'une qui est la chaleur.' (Baillet, *Vie de M. Descartes*, vol. 2, p. 37).

⁴⁶ On Regius, see J.A. De Vrijer, *Henricus Regius. Een 'cartesianisch' hogelaar aan de Utrechtsche hogeschool* (The Hague: M. Nijhoff, 1917); T. Verbeek, *La Querelle d'Utrecht* (Paris: Les impressions nouvelles, 1988); Idem, *Descartes and the Dutch: Early Reactions to Cartesian Philosophy, 1637–1650*, (Carbondale and Edwardsville: Southern Illinois University Press, 1992); idem, 'Regius's *Fundamenta Physices*', *Journal of the History of Ideas* 55 (2000): pp. 533–51; and V. Alexandrescu, *Croisées de la Modernité. Hypostases de l'esprit et de l'individu au XVII^e siècle* (Bucharest: Zetabooks, 2012), pp. 155–86.

In a second disputation he sustained in Utrecht on the circulation of the blood, in April 1641, Regius gave the Cartesian heating account (*coctio*) as the cause for the motion of the blood, with a twist: there occurs a ‘sanguification’ in the heart through the process of a ‘pulsific ebullition.’⁴⁷ The ‘pulsific ebullition’, not a Cartesian notion, is nothing more than a barbarism meant to replace Plempius’s ‘pulsific faculty’ with chemical ebullition. Descartes comments on Regius’s phrasing and speaks of a ‘general *coctio*’ (AT III 67), but he will not use this phrase in the accounts published in the *Passions of the Soul* or in the *Description*. One ‘sanguification’, following Regius, occurs through ebullition in the right ventricle, and another one in the left ventricle. The cause of the motion of the heart and arteries, while it consists essentially (*causa continens*) in the ebullition of the blood already found in the heart before the new blood flows in, relies nevertheless on a fourfold complex of concurrent, helping causes: (1) the ‘aptitude’ and the composition of the blood; (2) the heat of the heart; (3) the part of the blood which remains in the heart after the beating to act as a ferment; (4) the disposition of the vessels of the heart; and, he adds, ‘not [on] some particular pulsific faculty located in the heart and communicated by it to the arterial walls’.⁴⁸ This disputation was still directed against Plempius, who had maintained a pulsific faculty communicated through the arterial walls in his letters to Descartes and in his *Fundamenta medicinae* (1638).

⁴⁷ ‘In corde fit coctio, cum chymus sanguini a reliquo corpore ad cor redeunti permistus, et simul cum eo in Hepate praeparatus, in verum et perfectum sanguinem, per ebullitionem pulsificam, commutatur.’ (*Physiologia* [1641], 20, in *The Correspondence between Descartes and Henricus Regius*, p. 213).

⁴⁸ ‘Admirandus igitur ille Cordis arteriarumque motus, praeter sanguinis in corde existentis ebullitionem, quae causa ejus continens est, a quatuor antecedentibus perficitur causis; primo a sanguinis cor ingredientis ad dilatationem aptitudine; Secundo a cordis calore: Tertio a parte sanguinis, quae post singulos pulsus ardens, aut tanquam fermentum, in corde remanet: quarto a cordis vasorumque ipsius conformatione; non autem a peculiari facultate pulsifica cordi insita, et arteriarum tunicis ab ipso communicata.’ (*Physiologia* [1641], 21 in *The Correspondence between Descartes and Henricus Regius*, p.214).

In his *Fundamenta physices* (1646), Regius presented the account of the motion of the heart, as a good Cartesian, in the chapter on animals.⁴⁹ He restated the four remote causes from the 1641 disputation, but added as a second proximate cause for the heart's motion, alongside the rarefaction of the blood: the animal spirits gathered in the fibres of the heart.⁵⁰ The addition of the motion of the spirits in the account of cardiac motion is a development that seems Cartesian in spirit but not *in littera*: the motor action of the animal spirits, although recognized by Descartes, is never taken by him to be a cause of the circulation. The propagation of the blood through the entire body is accounted for mechanically as the communication of motion (both the motion of the blood and that of the spirits) down to every vessel, and this explains how some dying people continue to exhibit a spontaneous contraction and expansion of sanguine vessels, although their heart and their blood flow had stopped.⁵¹ At this stage, this can be seen as a development building on Descartes, in tune with the contemporary trends in the medical discourse. Descartes will present himself a developed account of the motion of animal spirits in his *Passions of the Soul* of 1649.

The letter from 1640 that Baillet reported already suggested this development, as we have seen. But there is one further evolution in Regius's physiology, which makes him less of a follower of Descartes. Up to 1661, his account for the origin of motion in the heart consists in Cartesian fermentation plus this agitation of the animal spirits, a double cause, sustained by certain dispositions found in the cardiac apparatus. However, in the third edition of his *Philosophia naturalis*, of 1661, Regius introduces a passage arguing that the agitation of the animal spirits is the 'principal' (*praecipua*) cause for the circulation, for the fermentation of the blood is too weak to push the blood throughout the body. He argues now explicitly against Descartes's account: 'it is

⁴⁹ *Fundamenta physices* (1646), p. 181. The chapter treats of animals in general, and then we get separate chapters on irrational animals (*De Bestiis*) and rational animals (*De Homine*).

⁵⁰ 'Itaque admirandus ille cordis arteriamque motus, praeter sanguinis in corde existentis rarefactionem, spirituumque animalium in fibras cordis influxum, quae eius causae sunt proximae, etc.' (Ibid., p. 181).

⁵¹ Ibid., p. 182.

not the rarefaction of the blood in the heart, but instead the movement of the animal spirits in the fibres of the heart, that which should be taken as the main cause between the proximate causes of the pulse'. And he develops:

Among the proximate causes of the motion of the heart, the main one, established here with necessity, is the very powerful flow back and forward of the animal spirits from the brain through the nerves in the fibres of the heart; for the rarefaction, the effervescence or the swelling of the blood which generally takes place in the heart is too thin, and thus too weak to be the main proximate moving principle, and much less the only one, needed to push and repel all of the blood from the heart back and forward, through all of the arteries and veins of the animal (as Aristotle in his *De Respiratione* and Descartes in the *Discourse on Method* state).⁵²

Let me venture an interpretation: Regius's addition of the flow of the spirits as a concurrent cause for the motion of the heart, and subsequently as its main cause, is meant to counter increasing attacks against Descartes's account with an alternative mechanical explanation.⁵³ Regius continued Descartes's

⁵² 'Inter causas proximas cor moventes, praecipua, et necessario hic statuenda, est satis validus spirituum animalium e cerebero per nervos in cordis fibras reciprocus influxus: cum rarefactio, effervescentia, sive intumescencia, sanguinis, quae communiter in corde fit, sit tantum exigua, et proinde nimis debilis, quam ut totum sanguinem, per totius animalium corporis arterias et venas, a corde et ad cor reciproce, tanquam praecipuum, nedum solitarium, (ut Aristoteles *lib. de respirat.* et Cartesius *discurs. de Method.* statuunt), proxime movens principium, pellat atque repellat.' (*Philosophia naturalis* [1661], p. 305–6).

⁵³ The passage I bring forward from the 1661 edition should be added to Thomas Fuchs's account of Regius's physiology of the heart (*The Mechanization of the Heart*, pp. 146–8). The addition is distinctly intercalated as a paragraph into text from previous editions. While Fuchs does bring forward Regius's account of the animal spirits as a concurrent cause for the

project to replace Aristotelian-inspired Galenic physiology with mechanism, be it with certified Cartesian explanations or not. Seventeenth-century Aristotelian physiology of the soul maintained a number of proximate causes subordinated to the original motor cause, the sensitive soul. Regius's strong materialist developments made clearer Descartes's opposition to the traditional Aristotelian views on the soul by explicitly using Aristotelian jargon. In doing so, he read closely the formulations of Aristotelian physiology and replaced every one of them with Cartesian ideas, including the Aristotelian complex of proximate causes subordinated to one primary cause. 'The life of the animal', Regius says, 'or its vivifying faculty (*facultas vivendi*), consists in this, that there is in it a certain part equipped with fire, which is called the heart, so hot that it heats up the nourishing juices flowing through the veins and parts of them are pushed out through the arteries, and then, after they are heated again, these juices flow back to the heart through the connected veins, continuously'. Circulation is thus no more no less than what the faculty of life consists in, sustained by the heat of the heart. More of this: 'The faculty of sense and movement, that people call the sensitive soul, is the arrangement and conformation of the parts of the animal in spirits, nerves and other sensitive organs', etc. (my emphasis).⁵⁴

Regius continued to push his anti-Aristotelian physiology through the 1660's explicitly against Descartes. Descartes had always been careful not to openly provoke the Aristotelianism of the schools, largely by ignoring its theses in his published work. It is precisely Regius's open attack that guardians of orthodoxy such as Plempius feared from the Cartesian mechanical explanation of

motion of the heart, he fails to add Regius's anti-Cartesian stance from 1661, and reads him as a Cartesian throughout. Cf. also J.A de Vrijer, *Henricus Regius*, p. 215 'In zijn grootere werken heeft Regius die cartesiaanische physiologie bijgehouden', etc.

⁵⁴ 'Vita animalis, seu ejus vivendi facultas, in eo consistit, quod quaedam in eo sit pars igne, tantum calido, instructa, quae cor dicitur, in quam alimentarius succus per venas influens incalescit, et in partes alendas per arterias impellitur, ac deinde, ut rursus incalescat, per continuas venas ad cor perpetuo refluit. . . . Facultas sentiendi et movendi, quae anima sensitive vulgo dicitur, est partim animalis in spiritus, nervos, et alia sensoria . . . attemperatio et conformatio.' (*Fundamenta physices* [1646], p. 153).

the cardiac motion: it undermined the hylomorphic structure of living bodies that was the framework and reference for their medical science. Not long after the quarrel with Plempius of 1640, Regius acquired a reputation for endangering the union of the body and soul by defending an accidental psychophysical union, which stirred a heated and famous controversy in Utrecht throughout the 1640's and occupied much of Descartes's energy for the remainder of his life. The Utrecht quarrel must have had a certain echo in Leuven. The Leuven theological reactions to which I turn next are best seen against Regius's move of developing from Descartes's physiology an upfront attack against Aristotelianism.

6.4 Libertus Fromondus (1587–1653) and the condemnations (1662–1663)

When Plempius received the *Discourse and Essays* in 1637, he forwarded one copy to his colleague and former teacher, Libertus Fromondus, as instructed by Descartes.⁵⁵ Fromondus was a good candidate for Descartes to win over. He needs no introduction after our chapter 4. By 1637 he had an established reputation as a defender of the integrity of the Catholic body of knowledge and was certainly the voice to be feared at Leuven from the Aristotelian camp.

Fromondus replied to Descartes rather bluntly and dismissed him as an atomist—as courtly and mischievously as possible. He even sent him a treatise against atomism he had written.⁵⁶ Granting him, almost sarcastically, the glory of a second Pythagoras or Epicurus in his endeavour to put all science on an entirely new track, he also added that, as clear as the author's ingenuity was, as obscure

⁵⁵ Plempius calls Fromondus his 'parent' (*parens*), AT I 399.

⁵⁶ *Labyrinthus sive de compositione continui* (1631). See chapter 4. The book is used by Leibniz as a compendium of arguments in the *Nouveaux Essais* (2, 23, 31) and the *Essais de théodicée* (*Discours préliminaire*, 24).

was the truth in his writings. He feared that Descartes might fall into the ‘crass philosophy’ of Epicurus, without realizing it.⁵⁷

Fromondus brought forth 18 articles of contention: three on the general philosophy of the *Discourse*, six on the *Dioptrics* and nine on the meteors. First of all, it’s the approach that fails: the reduction of real qualities to the mechanical principles goes sometimes too far.⁵⁸ As he moved on to attack Descartes’s explanations throughout the book, he raised objections to animal automatism and to the Cartesian theory of sensitivity. Objecting to the mechanics of the heart as responsible for bodily sensations, his concern was for safeguarding the sensitive soul: ‘the heat of the heart, without it being a sensitive soul, can exert in the body all the functions of the sensitive soul, apart from those of the rational soul’. And he continued in proper Aristotelian parlance:

He [Descartes] seems to say that heat, as that from heated hay, can exert in the human body all the animal operations, except for the operations pertaining to the rational soul. Thus the heat of the hay, without any other sensitive soul, can see, hear, etc. Such noble operations do not seem to be able to proceed from such a humble and brute cause.⁵⁹

⁵⁷ Descartes publicly tries to save face, saying to Huygens that ‘the dispute between us was more like a game of chess; we remained good friends’ (AT II 660). See AT I 449: ‘Et en effet je me réjouis, lorsque je vois que les plus fortes objections qu’on me fasse, ne valent pas les plus faibles de celles que je me suis fait à moi-même, auparavant que d’établir les choses que j’ai écrites’. He does send to Huygens though the replies he had given to Fromondus and to which the latter did not deem to answer, and at some point contemplates their publication—as per the letter to Plempius from AT II 345.

⁵⁸ ‘Nimis multa sperat se expediturum per solum situm, aut motum localem, quae sine realibus qualitatibus aliis non possunt, aut nihil intelligo.’ (AT I 408).

⁵⁹ ‘. . . videtur dicere quod calor, qualis in fœno calefacto, possit exercere omnes operationes animalis in corpore humano, exceptis actionibus propriis animae rationalis. Ergo calor fœni, sine alia anima sensitiva, potest videre, audire, etc. Tam nobiles operationes non videntur posse prodire ex tam ignobili et bruta causa.’ (AT I 403).

One could push this line of argument and ask why would the heat of the hay not make the hay itself see and hear? Descartes would probably answer that this is precisely what happens, once a certain level of complexity in the organized matter is achieved (the machine metaphor). The issue at stake is double: Descartes's account cancels both the divide between the sensible world and the material world and that between the sensible animals and the rational ones. The second consequence is more threatening for Fromondus. Descartes's mechanics of the heart and the reduction of the animal soul opens the path to a dangerous materialism: if one says that some of the operations normally attributed to the soul actually take place as a result of the functioning of a mechanism, then we are in danger of explaining all operations of the soul, including its purely intellectual ones, through this mechanism. It 'opens the way to the atheists, so that similar causes [motion provoked by heat] are assigned to the rational soul.'⁶⁰ He preemptively congratulated Descartes at the end of his letter for still holding the thesis of the immortality of the soul, as if it were something to be congratulated for, somewhat in spite of his other commitments.⁶¹ Fromondus's worries will take a clear shape shortly after, in the writings of Henricus Regius we have seen earlier.

Descartes himself would, however, painstakingly keep away from such impious implications. Since the matter is not only about the physiology of the heart, his avoidance of materialism and struggle to stay away from heresy will lead him to argue for the explanation of cardiac motion through a theory of the operations of the soul and a theory of sensations. Descartes will undertake for Fromondus this route, only too briefly. The explanation of the vision without intelligence, which Descartes puts forward for Fromondus as a reply to his suspicions of heresy, is the best argument that Descartes makes in this exchange

⁶⁰ 'Hinc etiam fortassis via sternetur atheis, ut etiam animae rationalis operationes simili causae tribuant, et eam corpore humano excludant, aut saltem materialem animam vice immaterialis nobis infarciant.' (AT I 403).

⁶¹ 'Delectat etiam me magis quod fide catholicus et spem nobiscum habeat post hanc vitam brevem aeternae.' (AT I 408).

and the key to its defence. He argues that mechanically explained sensations, such as those we find in animals, are not the same as sensations explained through the psychophysical union in man, which display the work of the rational soul:

He [Fromondus] supposes that animals see just as we do, i.e., being aware or thinking they see, which is said to have been Epicurus' view and is still almost universal. But [...] I explain quite explicitly that my view is that animals do not see as we do when we are aware that we see, but only as we do when our mind is elsewhere. [...] In such a case we too move just like automaton, and nobody thinks that the force of heat is insufficient to cause their movements.⁶²

Furthermore, Descartes continued, the animal soul (i.e., the Aristotelian vegetative and sensitive functions) is nothing else but pure blood, and he conveniently and heavily cited the Bible on that.⁶³ There is no soul-like faculty that would give rise to motion in living bodies, and hence Descartes's physiology of the heart is warranted to posit a naturally mechanical source of motion. Fromondus's point is to say that postulating this continuity between beasts and man through the mechanical physiology of the heart gives way to a dangerous materialism. Descartes's response is, on the one hand, to make clear where the line stands between the corporeal functions and the operations of the rational soul, and on the other hand to counter-attack by turning Fromondus argument

⁶² AT I 413 / CSMK 61–2. See the Replies to Hobbes, on the distinction between images and thought, especially Descartes's reply to Hobbes's sixth objection, AT VII 182 / CSM II 128, 'brute beasts cannot affirm or deny, even in thought; and hence cannot make judgements', etc.

⁶³ ' . . . cum Sancta Scriptura firmiter credo et, ni fallor, dilucide explicui, *animas brutorum nihil aliud esse quam sanguinem*, nempe illum qui, illorum corde calefactus et attenuatus in spiritum, ab arteriis per cerebrum in nervos et musculos omnes se diffundit', etc. (AT I 414).

against him, showing how his own account is the orthodox one and the Aristotelian conception of the soul is the truly heretic one: ‘Since these people posit so little difference between the operations of a man and of an animal, I do not see how they can convince themselves there is such a great difference between the natures of the rational and sensitive souls.’ He even offers a rare critique of the conceptual inconsistency of a sensitive soul: ‘On their view, when the sensitive soul is alone, its nature is corporeal and mortal; when it is joined to the rational soul, it is spiritual and immortal.’ Its functioning approaches ridiculousness: ‘it seems that on their view sensation in animals is closer to cognition in God and the angels than human reasoning is.’⁶⁴

Fromondus is not alone in warning of the danger of Descartes’s physiology. Gassendi, Hobbes, Bourdin or the sixth objectors, they all make the point that denying the animal soul and mechanizing the human sensitive soul is endangering the gap between animal and man and is offering to an atheistic mind the opportunity to extend that mechanism to the very operations of the rational soul. Descartes will dismiss this as a misunderstanding of the scope of his project, but the stigma remained. However, the proposal of a mechanistic vital principle—heat, or fermentation—is not only a dangerous step towards mechanising vital functions, but can be used with equal value as an argument for the psychophysical distinction, a point which Descartes made to Fromondus. The argument will be brought forward by Regius in his *Fundamenta physices* of 1646, and will be used by Cartesian apologetics throughout the rest of the century:

It is certain that if we attribute to animals a sensual, imaginative or any kind of intellect, be it a very low one, or any sort of cognition, then there would be no natural cause through

⁶⁴ AT I 415 / CSMK 62.

which one could say that the human mind is less corruptible than the soul of a dog, a fox or a monkey.⁶⁵

Regardless of Fromondus's opposition, by the end of the 1640's, Descartes's major publications were on the market and Cartesianism was gaining strength in Leuven. If professors like Arnold Guelincx, Gérard Van Gutschoven or Guillaume Philippi were professing Cartesian theses, the opposition was still strong.⁶⁶ In 1653, Plempius, holding his ground, initiated a campaign to get Cartesianism ousted from the University. His efforts amounted to not much: he sent a circular letter to a number of professors asking them to comment, censure and condemn Descartes's writings, and he published the letters he received as an appendix to his old anti-Cartesian treatise, the *Fundamenta* (1653 edition: *Doctorum aliquot in Academia Lovaniensi Virorum Iudicia de Philosophia Cartesiana*, pp. 375–87). The intent was to gather personal attacks in the form of 'censurae' from Leuven professors, as a plea for an official condemnation of the Cartesians in the university. Will Leuven stand still and allow this new philosophy to chase away its Aristotle, when Utrecht and Leiden have already condemned it?⁶⁷

Plempius's own letter serves as a preface to the small anti-Cartesian tract. His starting point is that Descartes's philosophy amounts to a revival of

⁶⁵ 'Et certe si bestiis sensualem, imaginativum vel quemlibet alium etiam vilissimum intellectum, vel qualemcunque cognitionem attribuamus, nulla causa naturalis dari potest, cur hominis mentem magis, quam animam canis, vulpis, vel simiae incorruptibilem esse dicamus.' (*Fundamenta physices* [1646], p. 242). On Cartesian apologetics and arguments defending his conception of the soul, see C. Fowler, O.P., *Descartes on the Human Soul, Philosophy and the Demands of the Christian Doctrine* (Dordrecht: Kluwer, 1999).

⁶⁶ See Monchamp, *Histoire du cartésianisme*, ch. XII (Arnold Guelincx), XV (Gérard Van Gutschoven), XVI (Guillaume Philippi), *passim*. On the contrary, the Carmelite professor François Crespin ou Bona-Spes mentions in his *Commentarii in universam Aristotelis Philosophiam* (1652) Descartes as having rejected substantial forms and 'nec multum abest Fromondus'. (Monchamp, *Histoire du cartésianisme en Belgique*, p. 211).

⁶⁷ *Fundamenta* (1653), p. 377b.

Democritus and should be treated as such; the rest of the letters are meant to detail this judgment. Out of the forgettable names that Plempius recruited, we will retain Fromondus's censorship as pointing out in detail the theological danger posed by Descartes. Leaving aside the contentious issue of the Eucharist, to which the bigger part of the letter is devoted, Fromondus nevertheless starts with combatting the physiological point of the non-existence of animal souls, which contravenes the Holy Writ. The argument is interesting. The fact that the death of humans and the death of mules is said to be *unus* by the Holy Writ (p. 379a, *unus interitus est hominis et iumentorum*) entails, according to Fromondus, the fact that the souls of humans and mules act as a *forma informans*. The destruction of man is the separation of the soul from matter, i.e., the end of the process of information of the matter by the soul. The Council of Vienne stated, against the Averroists, that the human soul is a *forma informans*, not a *forma assistens*, as the Cartesian-Democritean position could be interpreted. This entails that the soul of the mule is also a *forma informans*, informing matter, otherwise its destruction would not be the same with the destruction of man (p. 379a). Fromondus was actually reflecting here on his exchange with Descartes through Plempius (he states so himself, p. 378b), and he answered through this argument to Descartes's comment to Plempius, mentioned earlier, on the inconsistency of the Aristotelian position on death (AT I 514). But Fromondus goes on to express a very lucid criticism against the Cartesians from his own university. In following Descartes, they fail to teach their pupils about the range of faculties and vital functions of the soul, things that are of utmost necessity if they are to progress towards theological studies. Pupils understand Saint Thomas and 'the scholastics' easier, says Fromondus, just as they understand Galen in medicine easier, because they treat the various powers and faculties of the soul at length. Entering theology from a Cartesian training, one would be struck dumb by the proliferation of functions and the paraphernalia of powers of the soul needed there, and would not understand it, or worse, would become reluctant towards it. This seems like a very old-school position from Fromondus, a medieval view well alive in the middle of the seventeenth century. Physiology is not a science for itself; it should serve as a preparation to theology, and explaining the vital functions through motion alone does not help. The enquiry as to whether the faculties are distinct

from the soul *a parte rei* or just objectively should be done in theology, not in physiology; otherwise, it's like a harvesting a field too soon.⁶⁸

Fromondus died before his letter appeared in print (in 1653), but his anti-Cartesian position is consistent throughout his career from the moment he laid his eyes on Descartes's writings. His publication of a textbook on *The Christian Philosophy of the Soul* in 1649 should be weighed in this anti-Cartesian context.⁶⁹ Monchamp (1886, pp. 151–6) takes out a number of passages from this manual that seem directed against Descartes, but the fact is that Fromondus never mentions Descartes's name in his published books.⁷⁰ With his characteristic sensibility towards the ancients and from the high seat of his Leuven chair, Fromondus directs his *De Anima* against the Democriteans of the day and their Epicurean disciples, of various incarnations. This is not a polemical treatise. But it is not hard to see in this publication a reaction to the danger of Cartesianism creeping up in Leuven classrooms, if we look at it from the retrospective of the 1653 letter. The publication itself, in those years, seems to be act as a theological complement to Plempius's *Fundamenta Medicinae*.

Meanwhile, Rome itself became interested in the Leuven affair. On 3 July 1662 the Faculty of Arts of the University of Leuven held a meeting debating the installation of Cartesian doctrines in the university, as a response to an inquiry from the papal nuncio. It was only the beginning of a series of such meetings. In August, a bachelor student held and published a series of Cartesian medical disputations. The Apostolic Nuncio, having seen the student's placard, wrote a warning letter to the university rector, citing the Cartesian theses put forward

⁶⁸ 'Interim adolescens philosophus S. Thomam et Scholasticos in Theologia, Galenum et Medicos in vestra Medicina facilius intelliget, qui de potentiis et facultatibus animae tam multa et varia disserunt: ne adolescens, ubi ex ludis illis philosophicis, qui per motus locales, aut sicsehabentias satis explicare confidunt, ad superiores Scholas ascenderit, et de varia istarum animae facultatum supellectile loquentes audierit, obstupescat et sine conceptu remaneat.' (*Fundamenta medicinae* (1653), p. 380b). See G. Monchamp, *Histoire du cartésianisme en Belgique*, pp. 253–6.

⁶⁹ *Philosophiae Chrisitanae de Anima libri IV* (Leuven: H. Nempaeus, 1649).

⁷⁰ G. Monchamp, *Histoire du cartésianisme en Belgique*, pp. 151–6.

there: ‘that the arguments which give a soul to animals are not probable; that it is doubtful that animals live; that there is nothing new under the sun, except for the rational soul . . . [i.e.,] that no other [kind of] soul or qualities are produced anew, because there are none.’⁷¹ The recently recovered reports by the censors in Rome that motivated the decrees of condemnation issued by the Holy Congregation of Cardinals in 1662 and 1663 mention the same danger of the lack of the animal soul. The report on the *Passions of the Soul*, of the Roman censor Stephanus Spinula, alongside the condemnation of the account of the passions through the movements of the spirits, puts forward as a censorship-worthy thesis the following: ‘that no movement of the members of the body originates from the soul; and it is an error to believe that the soul gives motion and heat to the body’.⁷² Plempius will report in high spirits on the condemnation in his fourth edition of the *Fundamenta medicinae* (1664), which by now has become almost the equivalent of a journal series on anti-Cartesianism.⁷³

⁷¹ Letter of de Vecchi, in G. Monchamp *Histoire du cartésianisme en Belgique*, pp. 362–4 and J.-R. Armogathe and V. Carraud, ‘La première condamnation’, p. 130: ‘Argumenta quae brutis animam asserunt, non esse probabilia. Dubium esse an bruta vivant. Nihil sub coelo esse novi, seposita anima rationali—videlicet prout intelligi puto ab Authore—nullas animas, nullas qualitates de novo produci, quia nullae sint.’

⁷² J.-R. Armogathe and V. Carraud, ‘La première condamnation’, 112, give the text of the censure of Stephanus Spinula: ‘Nullum motum corporalem membrorum oriri ab anima; quin erroneum esse credere animam dare motum et calorem corpori.’

⁷³ ‘C’est ainsi que ce qui a été commencé à Louvain par la sacrée Faculté de Théologie, fille de l’Eglise romaine, appui du Siège apostolique, gardienne des dogmes véritables, a été achevé par la sacrée Congrégation des cardinaux’. *Preface* to the 1664 edition, XX, quoted by Monchamp, *Histoire du cartésianisme en Belgique*, p. 392.

Conclusion

The widespread view of the unorthodoxy of the animal-machine doctrine passed through the reduction of the sensitive soul that Descartes had accomplished in his account of the heartbeat. From this review of the anti-Cartesian reception in ‘the Leuven affair’, assessing the motivation leading up to the condemnation of Descartes’s physiology should take into account the following: the debate starts off with Fromondus’s and Plempius’s letters from 1637–1638, drawing on Descartes’s physiology from the *Discourse*; the exchange from 1637–1638 shifts quickly from an academic-style dispute about the circulation of the blood to the philosophical implications of Descartes’s account of the heartbeat, where the real disagreement lies; the concerted rejection of Descartes’s physiology from 1637–1638 will be sustained by the two professors’ subsequent publications; Fromondus’s letter makes explicit the theological implications of Descartes’s account on the heartbeat that Plempius was opposed to; Descartes’s debate with Plempius over the heartbeat is continued through Regius’s disputations and publications from 1640–1641; Plempius’s use of Harvey’s analysis of the systole is yet another way to counter Descartes, and his conversion to the circulation of the blood theory should be seen against this background, rather than as a victory of Descartes; Plempius’s anti-Cartesian campaign peaks in the edition of 1653, with Fromondus’s theological condemnation. Finally, Rome confirms Plempius’s efforts in 1662–1663.

Thomas Gariepy has shown that for the first generation of Cartesians in the Northern Low Countries it was the Cartesian reading of Harvey’s account of the circulation of the blood that represented ‘the cornerstone of a mechanical

physiology'.⁷⁴ The Leuven reception supports this view. When reading the first reactions to Descartes's cardiology, one assessment stands out: the medical explanation for the origin of motion in the heart and blood sits at the core of Descartes's project of rejecting the hylomorphic metaphysics of the Aristotelian sensitive soul, and it is immediately perceived as an attack on the medical establishment that went beyond the physiological matter. Descartes's account is read and discussed by careful defenders of the Aristotelian tradition such as Plempius or Fromondus and as putting forward a materialist danger discernible very early in Regius. Harvey's discovery of the circulation of the blood will be drawn into this Cartesian controversy and will be used by Aristotelian-minded physicians against Descartes, as Plempius does. At this stage, Descartes's argument for the theological good use of his physiology, expressed also by Regius, does little more than put fuel on the fire.⁷⁵ This comes to show how far along a physiological account can go, and the extent to which the propagation of Harvey's discovery of the circulation of the blood through Descartes is determined by theological constraints. Perhaps unintentionally, Descartes is not far from historical clairvoyance when saying that the acceptance or rejection of his explanation of the motion of the heart will determine the faith of his philosophical project.

⁷⁴ T. Gariepy, *Mechanism Without Metaphysics: Henricus Regius and the Establishment of Cartesian Medicine*, PhD thesis (Yale University: 1990), p. 316. I thank Thomas Gariepy for having provided me with a copy.

⁷⁵ Later on, Descartes's defence will catch on, to a certain degree. Antoine Arnauld's advocacy of Cartesianism shows how it can be taken as being a better position than either Aristotelianism or Thomism to explain both the gap between the animal kingdom and rational man and the separability of the human soul, with a simpler, upfront explanation that was virtually susceptible of being shown through experiments such as vivisections. On Arnauld's arguments, essentially the same as Regius's ones I reported, see C. Fowler, *Descartes on the Human Soul*, chapter 3.

7 Philosophia peripatetica emendata.

Bartholomeus Des Bosses on corporeal substance

The Aristotelian doctrine of corporeal substance was not abandoned easily. By the late seventeenth century, Aristotelianism was on the defensive, and one had to argue for its adequacy. But the influence between Aristotelianism and early modern philosophy goes both ways. While most Aristotelians of the seventeenth and eighteenth centuries simply ignore the early modern philosophers and their novelties, some openly fight them, while others embark on projects of accommodating Aristotelianism in the new climate.

This chapter follows the Aristotelian theory of corporeal substance, examined throughout the previous chapters, into the eighteenth century, after the main developments of the mechanical philosophy are well established. The study presents Bartholomeus Des Bosses's philosophical project and his development, from the correspondence with Leibniz to the outline of his *Clavis Lycaeï* of 1735. It argues the following: that Leibniz introduced the notion of a substantial bond, at the demand of Des Bosses, in order to secure the reality of extension; that Des Bosses had strong views on matter and extension, which could not be satisfied by Leibniz's proposal; that these views led him to reject Leibniz's notion of the substantial bond; and, finally, that Des Bosses developed his metaphysical ideas in 1735 by using some Leibnizian insights for his own agenda. Des Bosses's project allows us to better understand, retroactively, the text of the correspondence with

Leibniz. On a larger scale, it allows us to close our investigation of the avatars of the Aristotelian corporeal substance with an interesting, although perhaps not very defensible, attempt of revival.

7.1 Leibniz and Des Bosses

A few months before his death, Leibniz wrote to Des Bosses:

My doctrine of composite substance seems to be the very doctrine of the Peripatetic school, except that their doctrine does not recognize monads. But I add them, with no detriment to the doctrine itself. You will hardly find another difference, even if you are bent on doing so.¹

It is tempting to take Leibniz's profession of Aristotelian orthodoxy as circumstantial: the entire correspondence he had with the Jesuit Father Bartholomeus Des Bosses (1706–1716) is based on a project of reconciliation between his 'system' and the dogmas of the Catholic Church, mediated by Aristotelian philosophy.² But even so, this circumstantial determination does not

¹ 29 May 1716, LDB 365.

² Des Bosses presented this plan: 'Atque ex hoc scrupulo meo consilium meum, quale sit, dispicis: nempe ut notiones tuas salva, quantum fieri potest, earum substantia phrasibus Aristotelicis, aut potius has illis, et utrasque dogmatibus Ecclesiasticis accommodem.' (25 January 1706, LDB 6). As expected, Leibniz was delighted by the idea: 'TE vero, Vir Eximie, cum rectum iter ingredi videam emendandae atque exornandae philosophiae ad usum Scholae, ut juvenus non poenitendis principiis imbuatur, etiam atque etiam (pro ea quam mihi indulges libertate) hortari audeo, ne in re tanta Reipublicae, imo Ecclesiae desis.' (2 February 1706, LDB 8). He advised Des Bosses to compose a textbook on the model of the

undermine Leibniz's claim. After all, his lifelong effort to reform the notion of substance was directed towards a revival of the Aristotelian metaphysics of form and matter within a more defensible physics: an 'emended peripatetic philosophy', as he calls it.³ While Des Bosses embarked enthusiastically on this irenic project, as the years went by and the arguments unfolded in the correspondence, he came to express less confidence in the possibility of such a philosophical feat. For his part, Leibniz thought he was getting ever closer to Aristotelianism. This divergence suggests that they had different views either about Aristotelian metaphysics, or about Leibnizian metaphysics, or about both. I look here at the reasons for this divergence: in what sense thought Leibniz that he was an Aristotelian, and in what sense thought Des Bosses that Leibniz was not one?

Des Bosses has been usually presented in the scholarship on the correspondence as merely Leibniz's dialogue partner, but he also had philosophical ideas of his own.⁴ Born in 1668, Bartholomeus Des Bosses studied

popular *Summa philosophiae quadripartita* of Eustachius a Sancto Paulo, the same model that Descartes had initially contemplated for his *Principia*.

³ LDB 374. See M. Fichant, 'Mécanisme et métaphysique: Le rétablissement des formes substantielles (1679)', *Philosophie* 39 (1993): pp. 27–59 and 'L'invention métaphysique', in G.W. Leibniz, *Discours de métaphysique, suivi de Monadologie et autres textes* (Paris: Gallimard, 2004), pp. 7–140. On Leibniz's Aristotelianism, see C. Mercer, 'The Seventeenth-Century Debate between the Moderns and the Aristotelians: Leibniz and Philosophia Reformata', *Studia Leibnitiana Supplementa* 27 (1990): pp. 18–29; idem, *Leibniz's Metaphysics: Its Origins and Development* (New York: Cambridge University Press, 2001); and D. Garber, *Leibniz. Body, Substance, Monad* (Oxford: Oxford University Press, 2009).

⁴ On Des Bosses, outside the literature on the correspondence with Leibniz, see: J.-N. Paquot, *Mémoires pour servir à l'histoire littéraire des dix-sept provinces des Pays-Bas, de la principauté de Liège, et de quelques contrées voisines* (Louvain: Imprimerie Académique, 1764), vol. 4, pp. 172–6; C. Sommervogel, *Bibliothèque de la Compagnie de Jésus*, (Bruxelles: O. Schepens, Paris: A. Picard, 1890–1932), vol. 1, pp. 1856–8; W. Warnach, 'Ein Philosophischer Korespondent Leibniz. P. Bartholomeus Des Bosses, Professor am Tricoronatum von 1709 bis 1711 und von 1713 bis 1733', in *Tricoronatum: Festschrift zur*

humanities and philosophy and did his novitiate in Trier (1686–1689). He taught afterwards at Aachen and Hadamar and he studied theology in Münster, where he also became a professor of theology; he moved to Hildesheim in 1705, teaching ‘polemical theology’. In 1706 he went from Hildesheim to Hannover to find Leibniz, for unclear reasons, other than the admiration he professed in his letters. He continued his academic career in Cologne, where he died in 1738. His theological teaching duties explain perhaps why metaphysical subjects were not pursued with more drive, in spite of a manifest interest for them. His bibliography is rather thin: a Latin translation of a treatise belonging to the late-Jansenist controversy (*Epistolae Abbatis N. ad Episcopum N. quibus demonstratur aequitas Constitutionis ‘Unigenitus’*, 1715), a Latin translation of the *Theodicy* (1719), a polemical tract concerning the efficacious election (*Annotationes aliquot a unius e Societate Jesu Theologi ad excerpta quaedam ex assertionibus P. Pii Schöling O.P.*, Cologne, 1726), and a couple of other short pieces. Sommervogel names some ‘Fragments sur la géométrie, la métaphysique, etc.’, not found, while Paquot reports that he had gathered a ‘considerable number’ of books on Aristotelian physics.

Both Leibniz and Des Bosses came to their encounter in 1706 with their own baggage and with their own agendas. Leibniz was interested in Church affairs, intellectual gossip, the Jansenist controversy, privileged information on censorship, and in the theologian’s project of adapting the Leibnizian system to the philosophical views of the Society. Des Bosses had, on the face of it, a genuine interest in Leibniz. But he also thought he could use Leibniz’s philosophy for the defence of some Aristotelian positions concerning matter, forms and hylomorphism useful to his faction. His lifelong project appears to have been none other than to revive Aristotelian physics against that of the moderns, in a largely Thomist perspective, and to give a rational explanation of transsubstantiation in the Eucharist. I let Jean-Noël Paquot, who writes a generation after Des Bosses, to introduce him:

400-Jahr-Feier des Dreikönigsgymnasiums (Cologne: Kölner Universitätsverlag, 1952), pp. 126–38. Des Bosses’s correspondence is kept by the Société des Bollandistes in Brussels.

Le P. des Bosses eut surtout à coeur trois points, auxquels il donna toute son application: le 1. regardoit l'origine du Mal: le 2^d concernoit le sentiment de *S. Augustin* sur la grace de l'Homme avant & après sa chute, & sur le don de persévérance: le 3^e, auquel il travailla jusqu'à sa mort, étoit le rétablissement de la physique d'*Aristôte*, soutenue par *S. Thomas*. Persuadé que *Kepler*, *Gassendi*, *Descartes*, & *Newton* n'avoient rien imaginé, qui n'eût été renversé d'avance par ces deux chefs du Péripatétisme, & ayant apporté un soin infatigable à approfondir tous les mystères de cette secte, il entreprit de la relever du décri, où elle paroît tombée aujourd'hui.⁵

In what follows, I show that Des Bosses's agenda was incompatible with Leibniz's conception of corporeal substance outlined in the correspondence. In short, I hold the following story. Both Leibniz and Des Bosses were preoccupied with saving the reality of extension (as opposed to its phenomenality), but they had different understandings of how to do so and of why this was important. Leibniz offered the notion of the *vinculum substantiale* as a solution to the reality of extension, at Des Bosses's demand, and he moved towards establishing a world of extended corporeal substances alongside the world of non-extended monads. Des Bosses rejected Leibniz's understanding of the *vinculum* because he thought that it failed to account for a true Aristotelian notion of extension, as distinct from matter. While he never developed his views in a systematic manner, Des Bosses's project becomes clear in a later text from 1735. Des Bosses had one big idea: the key to reviving Aristotelianism was to ground a *real distinction* between matter and extension. He saw in Leibniz's monadology a tool to demonstrate the Aristotelian (or Thomist) prime matter he was after. For Des Bosses, the *vinculum*

⁵ J.-N. Paquot, *Mémoires*, p. 173.

must be superadded extension, not a substance, as Leibniz wanted. Des Bosses's agenda determines, in the end, his rejection of Leibniz's notion.

In the first section, I look at the way in which the concept of extension is developed in the correspondence and focus on Des Bosses's criticism of Leibniz. In the second section, I look more closely at Des Bosses's project as presented in an outline for a metaphysical treatise that he intended to write, but never did. In his bibliographical notes, Sommervogel mentioned a letter from 1735 to an unidentified Jesuit correspondent in which Des Bosses sketched the subject of a projected metaphysical treatise. The treatise is modestly called *Clavis Lycaeï*, the key to Aristotle's Lyceum, and is presented as something on which Des Bosses had worked for 'many years'. The *Clavis Lycaeï* is probably a development of that specimen of a *Dissertatio peripatetica de substantia corporea* announced to Leibniz in 1712.⁶ The text of the letter, which contains some metaphysical arguments that were to be included in the book, has been published by Michel de Certeau in 1966, although it has failed to attract scholarly attention so far.⁷ While the text is not very long, it is enough to give us a consistent picture of how Des Bosses thinks about extension, monads, matter, Aristotelianism and Leibnizianism. I conclude with a discussion of why Leibniz's views are incompatible with Des Bosses's conception of matter and extension.

⁶ LDB 216.

⁷ M. de Certeau, 'La « Clavis Lycaeï » du Père Barthélemy des Bosses', in *Archives de Philosophie* 29 (1966): pp. 570–93. LDB ignores the text, but the German edition of the correspondence, G.W. Leibniz, *Der Briefwechsel mit Des Bosses*, ed. and trans. by C. Zehetner and M. Benedikt (Hamburg: F. Mainer, 2007), includes a translation of it in an appendix.

7.2 The year 1712

Leibniz introduced in 1712, in his correspondence with Des Bosses, a new metaphysical notion, the *vinculum substantiale*, and much of the rest of the exchange is devoted to the discussion of this notion and of its potential use in securing a sound conception of corporeal substance. The *vinculum substantiale* has puzzled many commentators, mainly because Leibniz's position in this text is evolving from letter to letter and is very hard to pin down. Without going into the details of the text, I want to begin by dissociating two problems to which the *vinculum substantiale* is offered as a solution. (1) One is the problem of *the reality of extension*: how can the Leibnizian non-extended monads give rise to a world of extended bodies or corporeal substances? Is extension a mere 'phenomenon', as Leibniz calls it, or can it be something physically 'real', grounded in substance itself, that is, in the monads? (2) The other is the problem of *the unity of corporeal substance*: if the notion of substance applies primarily to the simple substance (the monads), how can an aggregate of simple substances compose a composite corporeal substance that is a *unum per se*? These two problems are closely connected by Leibniz in such a way that one cannot be dissociated from the other. The notion of a *vinculum substantiale* is meant to solve both of them. Leibniz will hold in this correspondence that corporeal substance (a notion that he applies to organisms or machines of nature) is united in virtue of this *tertium quid*, a 'real unifier', a *vinculum*; at the same time, this principle of unity, also called a *realisans*, endows corporeal substance with continuity and a principle of resistance necessary for 'real' extension. Extension can only be made 'real' if the corporeal substance is united. Whether the notion of the *vinculum substantiale* is coherent and successful in securing a notion of corporeal substance for Leibniz is not our main concern here.⁸ The reason I

⁸ For Leibniz's late conception of corporeal substance, see R.M. Adams, *Leibniz: Determinist, Theist, Idealist* (New York: Oxford University Press, 1994); M. Fichant, 'Leibniz et les machines de la nature', *Studia Leibniziana* 35 (2003): pp. 1–28; P. Phemister, *Leibniz and the Natural World. Activity, Passivity and Corporeal Substances in Leibniz's Philosophy*

dissociate, artificially, the two Leibnizian problems—the reality of extension and the unity of the corporeal substance—is that Des Bosses manifests a high interest in only one of them.

Des Bosses appears to be interested primarily in the problem of extension and its distinction from matter, and not in the problem of the unity of the corporeal substance. This could be explained by Des Bosses's Aristotelian background. One needs to keep in mind that Des Bosses comes to the discussion with Leibniz with an interest in an 'Aristotelian' notion of corporeal substance. The Aristotelian position on corporeal substance he has in mind is in stark contrast with that of Leibniz. According to the Aristotelian position (or, rather, Thomist), the 'composite' of matter and form which constitutes all corporeal substances is a given; it is only through a secondary act of abstraction that we enquire into its composition (e.g., out of matter and form or out of soul and

(Dordrecht: Springer, 2005); and D. Garber, *Leibniz*. For an overview of the Anglo-Saxon debate over realism vs. phenomenalism in late Leibniz, see G. Hartz, 'Why Corporeal Substances Keep Popping Up in Leibniz's Later Philosophy', *British Journal for the History of Philosophy* 6 (1998): pp. 193–207. Among the literature on the Leibniz–Des Bosses correspondence, see K.M. Kahle, *Leibniz's Vinculum substantiale* (Berlin: Logier, 1839); E. Rösler, 'Leibniz und das Vinculum Substantiale', *Archiv für Geschichte der Philosophie* 27 (1914): pp. 449–56; M. Blondel, *Une énigme historique: Le Vinculum substantiale, d'après Leibniz et l'ébauche d'un réalisme supérieur* (Paris: Beauchesne, 1930) and *Le lien substantiel et la substance composée d'après Leibniz. Texte latin (1893)*, ed. and trans. by C. Troisfontaines (Louvain, Paris: Nauwelaerts, 1972); A. Boehm, *Le « vinculum substantiale » chez Leibniz. Ses origines historiques* (Paris: J. Vrin, 1938); V. Mathieu, *Leibniz e Des Bosses, 1706–1716* (Turin: Pubblicazioni della Facoltà di lettere e filosofia, vol. 12, fasc. 1, 1960); C. Frémont, *L'être et la relation* (Paris: J. Vrin, 1981); A. Robinet, *Architectonique disjonctive, automates systémiques et idéalité transcendantale dans l'œuvre de Leibniz* (Paris: J. Vrin, 1986), pp. 83–110; B. Look, *Leibniz and the Vinculum Substantiale* (Stuttgart: Franz Steiner Verlag, 1999); B. Look and D. Rutherford, *Introduction to LDB*. European commentators are more sympathetic to the notion than their trans-Atlantic counterparts, ranging from Frémont's appreciation of the central role of the transsubstantiation in the development of the system to Blondel's recovery of the *vinculum* in his Christology.

body).⁹ In contrast, for Leibniz, the problem is one of unifying already given substances, the monads—hence the *vinculum* that glues them together. In a letter from 12 February 1706 Des Bosses expressed a view on the union of the corporeal substance contrary to that of Leibniz: the metaphysical union of the corporeal substance cannot be a relation that presupposes already constituted substances.¹⁰ It is important to retain that Leibniz and Des Bosses's approaches to corporeal substance started from opposite directions. The primary substances for an Aristotelian are the corporeal substances, while the primary substances for Leibniz are the monads. Des Bosses did not need the *vinculum* as a solution to the unity of the corporeal substance: he did not think that the corporeal substance was composed in the first place.

In this section, I take Des Bosses's perspective. I will leave aside the discussion of the unity of corporeal substance and Leibniz's intricate views on this, which have been sufficiently treated by Leibnizian scholarship. I will present instead Leibniz's introduction of the substantial bond in 1712 as a response to the need for grounding the reality of extension, which was Des Bosses's interest, and Des Bosses's criticism.

⁹ For the Thomist position, see e.g., the argumentation from *Sum. theol.* I^a, q. 76, a. 1. For a recent commentary, see R. Pasnau, *Thomas Aquinas on Human nature* (Cambridge: Cambridge University Press, 2004), ch. 3. We need to keep in mind that Des Bosses had, most likely, Thomist leanings, through his Jesuit education, as testified also by Paquot's report on his preoccupations quoted earlier.

¹⁰ 'Hoc mihi certum est: non posse eam [i.e., metaphysicam unionem] in modo relativo constitui. Relationes enim, uti alia accidentia substantiam jam constitutam supponunt. . . . Quare dicendum mihi videtur, hoc quidquid est quod praeter animam et corpus substantiam individuum constituit ipsam esse existentiam absolutam totius substantiae concretae quam Aristoteles et S. Thomas a materia et forma (quae scilicet substantiae essentia sunt) distinctam, unamque utrique communem statuunt.' (LDB 18).

7.2.1 Leibniz on extension

One of the recurring ideas in Leibniz's self-critique of his monadology¹¹ in the correspondence with Des Bosses is that it leads to a non-extended world, a world of appearances, in short, to idealism and *phenomenalism*. In his later years, Leibniz recurrently expresses the view that physical bodies are merely 'well-founded phenomena', the only 'real substances', existing in the external world, being the monads. There are several ways in which Leibniz explains how the monadology leads to phenomenalism and what phenomenalism means in the correspondence with Des Bosses (while his overall evolution on this topic is much more complex).¹² A basic way of understanding extension as phenomenal is the following: if all we have in the external world are individual monads, then bodies are mere aggregates of monads, because only the simple substances have true substantial unity, and monads can not interact, in order to 'unite' themselves in any real sense. Leibniz writes to Des Bosses:

If you deny that what is superadded to monads in order to make a union is substantial, then a body cannot be said to be a substance, for in that case it will be a mere aggregate of monads, and I fear that you will fall back on the mere phenomena of bodies. . . . Each [monad] is, as it were, a certain world apart, and they harmonize with each other through their

¹¹ The term 'monadology' is used here in the sense of a doctrine, not to be confused with the text edited as 'Monadologie' by Köhler in 1720 and as 'Principia philosophiae' the next year in the *Acta eruditorum*. It refers hereafter to the view that the ultimate elements of reality are simple substances, and that there is nothing ontologically real in the external world over and above the monads.

¹² See Garber, *Leibniz*, ch. 7, describing 'a family of phenomenalisms' in Leibniz.

phenomena, and not through any other intrinsic intercourse and connection.¹³

In the absence of a substantial bond, Leibniz continues,

. . . then all bodies with all their qualities would be only well-founded phenomena, like a rainbow or an image in a mirror—in a word, continuous dreams that agree perfectly with one another; and in this alone would consist the reality of those phenomena. For it should no more be said that monads are parts of bodies, that they touch each other, that they compose bodies, than it is right to say this of points and souls.¹⁴

In this view of bodies as mere aggregates of monads, extension is a mere phenomenon, a ‘coherent appearance’ arising out of the harmonization of the perceptions of each monad. Leibniz suggests that this harmonization and unity is imposed by a perceiver upon a heap of monads, which constitutes, in reality, a mere aggregate. Leibniz develops this view at length in the correspondence. One of the problems he faces is how exactly can we speak of a *single* harmony of perceptions that we can call ‘a body’, or how it is that each of us perceives the same artificial unity in a heap of monads to recognize it as a single individual body. Leibniz develops this idea in an interesting passage from a supplementary study to the letter to Des Bosses from 15 February 1712. He suggests in this passage that, in order to secure the phenomenal unity of disparate perceptions, we should consider God as the ultimate perceiver. In this case, a heap of monads has an absolute phenomenal unity given by God’s perception of it, while our

¹³ 27 May 1712, LDB 241–3; a similar position is expressed at LDB 224–6.

¹⁴ 15 February 1712, LDB 227.

individual perceptions impose only relative phenomenal unities on the heap of monads, unities dependent on our own individual perception:

If bodies are phenomena, and are judged by our appearances, they will not be real, since they will appear differently to others. Thus, the reality of bodies, space, motion, and time seems to consist in this: that they are the phenomena of God, that is, the object of his knowledge of vision.¹³ And the difference between the appearance of bodies with respect to us and their appearance with respect to God is in some way like the difference between a drawing in perspective and a ground plan. For whereas drawings in perspective differ according to the position of the viewer, a ground plan or geometrical representation is unique. God certainly sees things exactly such as they are according to geometrical truth, although likewise he also knows how each thing appears to every other, and thus he contains in himself eminently all the other appearances.¹⁵

In any case, what we should retain is that Leibniz thinks that monads can only secure a phenomenal extension, in direct relation with the mind of a perceiver, and that the substantial bond should address this problem. Leibniz had established, with the monadological view, a *derivative* character of extension, against the Cartesian position that took extension as primary: extension presupposes a certain nature as primitive (monads), in the same way, Leibniz claimed, as a number presupposes the thing numbered.¹⁶ The danger he perceives

¹⁵ LDB 231–3.

¹⁶ Cf. a clear text on this, ‘Addition à l’explication du système nouveau’ (1702 [?]), GP IV 589: ‘La fausse notion d’étendue que se forment les Cartésiens, comme si c’étoit un attribut primitif et capable de constituer une substance, leur fait beaucoup de tort, en les faisant

now is that deriving extension from the monads is impossible, or it relegates it to phenomenality. He explained at one point that the notion of extension is derivative in the same sense in which the notions of space and time are derivative: mere phenomena of a perceiver.¹⁷

Des Bosses, for his part, was not happy with the phenomenal character of extension, and he pushed several times for grounding extension in the monads themselves, not in the perceiver.¹⁸ Serious issues were at stake, not the least of which was the Catholic understanding of transubstantiation in the Eucharist, which relied on a robust notion of extension that sustained the species of the host.¹⁹

As already mentioned, when Leibniz began to seriously explore the notion of a ‘real extension’ in a world of monads in 1712, triggered by Des Bosses’s project. Des Bosses had set himself to write a dissertation on the Peripatetic conception of the corporeal substance and was willing to send it to Leibniz, on the condition that the latter would comment on it (January 28, 1712, LDB 216).

croire, qu’on peut concevoir une substance sans action, au lieu que la notion de l’étendue est dérivative, à peu près comme celle du nombre et du temps, incapables de constituer une substance, car l’extension ou étendue est relative et suppose quelque nature qui est étendue et répétée, tout comme le nombre suppose quelque chose dont on fait le dénombrement (*res numeratum*).’

¹⁷ See 13 January 1716, LDB 362: ‘Extensionem concipere ut absolutum, ex eo fonte oritur quod spatium concipimus per modum substantiae, cum non magis sit substantia quam tempus.’

¹⁸ See especially his letter from 30 July 1709, LDB 134–6, where Des Bosses claimed a continuity in the monads, as a principle of extension: ‘Sed puto monadas ipsas, de quibus sermo erat, ut meras Materiae modificationes aut terminationes considerari non posse, cum potius principia sint et fundamenta massae sive extensionis, imo potius extensio juxta te est modificatio monadum seu substantiarum. Sed et monades continuitatem habent, extensio enim et continuatio ex repetitione substantiae oritur.’

¹⁹ See X. Tilliette, ‘Problèmes de philosophie eucharistique. I. Descartes et Leibniz’, *Gregorianum* 64 (1983): pp. 273–305. Tilliette’s excellent study is the reason I do not treat the topic of transubstantiation more extensively, in spite of its importance for the present discussion.

Leibniz did not wait for the text to come to offer his own thoughts on the matter. It was obvious for Leibniz that such a dissertation could not work with the phenomenal conception of extension he had offered, which had little to do with peripateticism. Nevertheless, he was intrigued by the idea of forging a peripatetic notion of corporeal substance in Leibnizian terms:

I shall read with great pleasure your dissertation on corporeal substance. If corporeal substance is something real over and above monads, as a line is taken to be something over and above points, we shall have to say that corporeal substance consists in a certain union, or rather in a real unifier superadded to monads by God, and that from the union of the passive powers of monads there in fact arises primary matter, which is to say, that which is required for extension and antitypy, or for diffusion and resistance.²⁰

What Leibniz has in mind with this ‘real unifier’ is to ground the unity of monads needed for extension in a superadded feature of the world, created by God, as opposed to an appearance of unity dependent on the perceiver. The ‘real unifier’ gives rise to extension by uniting the primitive passive forces of the ingredient monads and thus ‘producing’ antitypy, continuity or diffusion of parts—features of extension. Leibniz therefore proposed to Des Bosses a separation of metaphysical paths: either we posit monads alone and phenomena constituted by God’s knowledge, and so extension too will be a mere phenomenon (this time he proposed that God acts as the perceiver), or we posit a unifying *tertium quid*, a direct product of God’s volition, that produces continuation and extension:²¹

²⁰ 15 February 1712, LDB 225.

²¹ ‘ . . . addet aliquam novam substantialitatem seu vinculum substantiale, nec solius divini intellectus, sed etiam voluntatis effectus erit.’ (LDB 232).

Thus, one of two things must be said: either bodies are mere phenomena, and so extension also will be only a phenomenon, and monads alone will be real, but with a union supplied by the operation of the perceiving soul on the phenomenon; or, if faith drives us to corporeal substances, this substance consists in that unifying reality, which adds something absolute (and therefore substantial), albeit impermanent, to the things to be unified.²²

Leibniz will bring a number of important clarifications to the notion of the *vinculum* throughout the correspondence, although the main view is already in place in 1712. An important change appears in August 1713, when Des Bosses pointed out that there was no reason to think of the unifier as ephemeral. Leibniz

²² LDB 225–7. B. Look, *Leibniz and the ‘Vinculum Substantiale’*, has helpfully insisted on the connection between the question of a ‘metaphysical union’ between body and soul—a notion that Leibniz had refused to De Volder and Tournemine—and the proposal of the substantial bond. However, focusing on this connection should not obscure the fact that the substantial bond was put forward in 1712 as a solution for the reality of extension and as an escape from phenomenalism, at the demand of Des Bosses. In my view, the substantial bond should be read in the context of an effort of constructing an Aristotelian notion of extension for Des Bosses’s dissertation. Although the insufficiency of the pre-established harmony to explain the union of body and soul is in the background of the discussion, it is not the main concern for the introduction of the substantial bond. See also D. Garber, *Leibniz*, pp. 367–82, who views the doctrine of the correspondence as a search for an alternative to phenomenalism, and A. Robinet, *Architectonique disjonctive*, pp. 84–5, who rightfully points out that the *vinculum* is an avatar of the scholastic *forma corporeitatis*, a notion which Leibniz had discussed with Arnauld.

agreed and granted a permanent status to the substantial bond.²³ What interests the present discussion, namely the notion of extension as a feature of the substantial bond, remains nevertheless the same. The substantial bond is said to add a principle of resistance to the composite substance, a source of extension ('if you add composite substances, I would say that in these things a principle of resistance must be added to the active principle or motive force').²⁴ In short, Leibniz's position is that 'real continuity can arise only from a substantial bond.'²⁵

Des Bosses opposed this conception of the substantial bond in his reply from 20 May 1712, with two claims:

(1) *The bond cannot be a substance*, as Leibniz wanted. It has to be an accident, for it *naturally* requires the monads it bonds. Moreover, it is an absolute accident, and not a mode: 'we shall now have in bodies something absolute, distinct from monads, that is not a substance. And so body, since it superadds to the monads nothing except this absolute thing, will superadd only an accident to them.'²⁶

2) *This absolute accident is nothing more than extension*. 'And so, in fact, it seems necessary to have recourse to some unifying thing, which can be called absolute accidental extension.'²⁷

Des Bosses's criticism pictures a view quite different from that of Leibniz: the *vinculum* for him is an accident, identified with extension, whereas for Leibniz it is a substance, and extension is a mode of this substance. In order to understand Des Bosses's criticism, we need to follow a parallel discussion on the ontological status of extension as either an accident or a mode, a question that has often been on Des Bosses's mind and one to which he returned a number of times in the correspondence.

²³ 'Et ideo re expensa hactenus sententiam muto, ut putem jam nihil oriri absurdi, si etiam vinculum substantiale seu ipsa substantia compositi dicatur ingenerabilis et incorruptibilis.' (LDB 319).

²⁴ LDB 232.

²⁵ LDB 371.

²⁶ LDB 237.

²⁷ LDB 239.

7.2.2 Des Bosses on extension

In 1707, Des Bosses wrote to Leibniz:

And as we are discussing modes, I am eager to know what you think about the quantity of mass or extension that you somewhere say is nothing but the continuation or diffusion of the already presupposed striving and resisting, or resistance, of a substance. Is this very continuation or diffusion only a mode of substance, or is it something that is more than modally distinct from it, that is, an absolute accident?²⁸

Leibniz ruled out the scholastic notion of real accidents, as accidents superadded to a substance but separable from it. He distinguished only between substances and their modes, with no middle entity. Therefore, he held extension to be a mode. As he explains, extension is only the continuation of situated things, just like a line is a continuation of points, and not a superadded entity.²⁹ Des Bosses, for his part, defended a position on extension as a real accident. Traditionally, the separation between extension as a real accident and the substance to which it is attached was needed by the Thomist explanation of the Eucharist (the extension of the bread is kept, sustaining the species, while the

²⁸ 21 July 1707, LDB 91.

²⁹ ‘Cum dico Extensionem esse resistentis continuationem, quaeris, an ea continuatio sit modus tantum? Ita putem: habet enim se ad res continuatas seu repetitas, ut numerus ad res numeratas.’ (LDB 98).

substance of the bread, its matter and form, are replaced with Christ's body). A real accident of the kind that Des Bosses has in mind has a middle status between a substance and a mode. For Des Bosses, extension has an accidental status because it presupposes the existence of a substance that is continued, it is a continuation of *something*. But it is more than a mode, because it is susceptible of being separated by God's power, and therefore it has a reality distinct from that of the substance in which it inheres.

Des Bosses initially argues for the real distinction between matter and extension by appealing to Leibniz's monads. Since non-extended substances such as monads could not possibly produce extension on their own, extension could not be reducible to the monads, and therefore it must be a superadded entity. He wrote to Leibniz in 1712:

I am confirmed in the view accepted far and wide among us, namely, that extension is a real accident and not just a modal one. It is indeed an accident because it presupposes a primary being or substance that is already constituted, and it does not constitute a substance as matter and entelechy do. On the other hand, it is real and not modal because, just as nothing that is not active in itself can become active by a modification alone, so I cannot conceive how that which is not extended in itself (as matter and forms are not extended in themselves) could have the power to become extended from a mode alone. If you will concede that this one accident is real and coeval with matter, I shall not fear relegating the rest to the level of modes.³⁰

³⁰ 15 February 1712, LDB 221.

Des Bosses thus can use Leibniz's monads to argue for a 'received' opinion on extension as a real accident. As we have seen, in 1712 Leibniz's position is that extension can only be grounded in the substantial bond itself, and not in the monads. Starting with 1712, Leibniz held that corporeal substances must consist in the substantial bond itself, and the connection between the monads and the substantial bond started to become more and more loose. Leibniz now held the bond requires the monads only 'physically' and not 'metaphysically' (i.e., without logical necessity):

I should think that composite substance, or that thing that produces a bond of monads, since it is not a mere modification of monads or something existing in them as subjects (for the same modification could not be in many subjects at the same time), depends upon monads. This is not a logical dependence (that is, such that it cannot be supernaturally separated from them) but only a natural one, namely, such that it requires that they unite in a composite substance, unless God wills otherwise.³¹

Once the substantial bond is introduced as a substance on its own, there is not much of a relation between monads and corporeal substance to speak of (besides that of a vague 'echo').³² The substantial bond is not, in the end, supposed

³¹ 20 September 1712, LDB 269–71. The metaphysical independence of the *vinculum* is restated a number of times until the end of the correspondence. See 29 May 1716, LDB 366: 'Interim vinculum hoc substantiale naturaliter non essentialiter vinculum est. Exigit enim monades sed non essentialiter involvit, quia existere potest sine monadibus, et monades sine ipso.'

³² 'Monades influent in hoc realisans, ipsum tamen in ipsarum Legibus nil mutabit, cum quicquid modificationum habet ab ipsis habeat quasi Echo, naturaliter scilicet, non tamen formaliter seu essentialiter, cum Deus ei tribuere possit quae Monades non dant, aut auferre quae dant.' (6 April 1715, LDB 336).

to bond monads after all, and Leibniz moved towards a picture of things very different from what Des Bosses had in mind. This evolution presents serious consequences for Des Bosses. On the one hand, severing the ties between the corporeal substance and the monads undermined the only argument that Des Bosses had for positing extension as a superadded accident. He could no longer claim that extension needs to be superadded to monads as an accident, because the monads were, so to speak, out of the picture. The bond unites the monads physically, but not logically; as a substance, it can exist on its own, without the monads. On the other hand, grounding extension in the substantial bond in the way that Leibniz did led inevitably to the view that extension is merely a mode, a property of the substantial bond itself.

From this point on, the dispute over the modal or accidental status of extension is moved over to the *vinculum*. Until the end of the correspondence, the positions remain unchanged. Des Bosses will hold the *vinculum* to be an accident because it presupposes the monads, while Leibniz will maintain that it is a substance on its own, which does not need the monads. Since Leibniz refused a real distinction between the *vinculum* and extension, Des Bosses had to keep a real distinction between the bond (identified with extension) and the monads, in order to maintain that extension is a real accident superadded to the monads. For Des Bosses, this meant that the *vinculum* and the monads are not separate substances, but distinct metaphysical parts of the same substance, just as extension and matter are distinct metaphysical parts in one substance. This meant refusing that the *vinculum* was a substance on its own, as Leibniz insists. Des Bosses could not grant that level of independence between the monads and the substantial bond, and so in the end he rejected Leibniz's notion.

We can conclude that Des Bosses developed a considered view on the relationship between the monads and the *vinculum substantiale* much different than that of Leibniz. While Leibniz took both the *vinculum* and the monads to be separated substances, Des Bosses wanted to keep them together. In doing so, he relegated the monads to the status of 'incomplete substances', subordinated to the *vinculum*. Des Bosses argues, appealing to the Thomist distinction between essence and existence (a notion far removed from Leibniz), that monads are independent *complete* substances with respect to their essence, but not with

respect to their existence. It is only when united by a substantial bond that they have proper existence, but in that case they are no longer *complete* substances, since they are subordinated to the *vinculum*:

. . . monads, considered with respect to their essence by abstracting from all existence or physical actuality, are indeed substances and metaphysically complete primary beings, since they have metaphysical actuality, that is, an entelechy; but they are not complete in the manner of a physical substance, except insofar as and when a dominant entelechy bestows existence and therefore unity on the whole organic mass, for example on the body of the horse, so that this mass itself is subordinate to no other entelechy.³³

He uses another analogy for the same idea. The status of the monads in composite substances is analogous to that of the elements in a compound (according to the Averroist and Thomist doctrine): they exist independently, with respect to their essence, but while in the compound their existence is subordinated to that of the compound (LDB 247). Just as, for Saint Thomas, body and soul lose their status as independent substances when joined together in the *per se* composite, so the monads lose their independent substantiality when unified by the bond. Otherwise, the composite substance could not be said to be a composite *of* monads.

The downside of Des Bosses's view is that the monads are no longer the primary substances of Leibnizian monadology. Des Bosses's position was, in the end, quite contrary to Leibniz's basic achievements. I now turn to the document from 1735 where Des Bosses developed his ideas more extensively, two decades after his exchange with Leibniz. This document will tell us just how strongly Des Bosses felt about the real distinction between matter and extension, and support

³³ 12 June 1712, LDB 247.

my reading that Leibniz's notion of corporeal substance was incompatible with what Des Bosses had in mind.

7.3 The year 1735

Des Bosses's projected metaphysical treatise, the *Clavis Lycaeï*, seeks to prove, according to the letter from 1735 mentioned in the introduction, that: '(1) matter is a *thing* distinguished from extension, and (2) that there is more than a *modal* distinction, consequently a *real* distinction, between matter and the primitive corporeal forms' (f. 5).³⁴ We find in this preoccupation a striking reflection of the discussion he had with Leibniz many years before. The two propositions are equivalent.

Des Bosses presents a first and straightforward argument proving them that he intends to further develop in his book, in a geometrical order. All geometers agree that extension is infinitely divisible, and even its smallest parts must be extended; by contrast, matter is made up of an infinity of non-extended indivisibles; hence matter must be distinct from extension. The minor is proved in the following way: matter is incorruptible, as all philosophers agree, and therefore must be composed out of incorruptible parts; everything that is extended is also divisible and therefore corruptible; hence, matter must be composed out of non-extended indivisible parts (ff. 6–7). But since this argument is based on the 'incomprehensible nature' of the infinite, Des Bosses says, he will also provide other arguments along the way.

Fortunately, there are enough details in the letter to let us understand the scope of this demonstration more clearly. Des Bosses's philosophical project is inscribed in the Society's efforts against Cartesianism and his treatise seeks to argue against the Cartesian identification of extension and matter. One of Des

³⁴ De Certeau, 'La « Clavis Lycaeï »'. I reference the letter by the numbers of the folios sending to de Certeau's transcription.

Bosses's targets is a book by one Étienne-Simon de Gamaches, called *Système du Mouvement* (f. 5). Gamaches was a Cartesian astronomer and moralist appreciated by the Académie des Sciences who thought that the Newtonian idea of absolute space posed the threat of reverting to Aristotelianism. If Cartesians were to recognize absolute motion, Gamaches thought, they would also have to recognize an absolute space distinct from extension, because only in this way they would be able to individuate a body in motion with respect to space. An absolute space entails that something besides extension must be posited in matter. Once the identification of matter with bare extension is dropped, one would have no basis on which to deny the entrance of other entities into matter, such as Aristotelian forms. As a matter of fact, one could in this way posit a plethora of other entities in matter, from powers and sensible qualities to secondary causes, substantial forms and even occult qualities. Thus, Gamaches argued, it was essential for Cartesianism to resist Newtonianism on this point, namely on the idea of absolute space, unless it wanted to revert to Aristotelianism.³⁵

This was exactly what Des Bosses wanted: to revert to Aristotelianism and re-introduce forms and qualities in matter by establishing firmly that matter was really distinct from extension. A second part of his dissertation would deal with

³⁵ É.-S. de Gamaches, *Système du Mouvement* (Paris: J.-M. Garnier, 1721), pp. 83–4: 'Dès qu'ils [les cartésiens] savent qu'il n'y a point d'autre étendue que celle de la matière, il est clair que s'il veulent s'en rapporter à leurs propres idées, il faut qu'ils reconnaissent que l'état des corps est non seulement indéterminé par rapport à nous, mais qu'il est encore indéterminable en lui-même. Je suis sûr qu'il n'y a point de cartésien dévoué à l'erreur du mouvement absolu qui, ayant fait cette réflexion, n'ait souvent été tenté de reconnaître un espace distingué de la matière; mais l'embarras, c'est qu'on sent bien que si la matière est autre chose que de l'étendue, il ne faut plus la restreindre à n'avoir pour propriétés que des figures et des simples changements de rapport de distance, et dès lors on n'est plus en droit de lui refuser ni les forces ni les vertus ni les qualités sensibles dont le Cartésianisme la dépouille. Il faut même souffrir qu'on réhabilite les causes secondes, les qualités occultes et les formes substantielles: car tout cela peut fort bien être l'apanage de ce qui constitue l'essence de la matière, si la matière et l'étendue ne sont plus la même chose.'

substantial forms (f. 11–12), thus following precisely the path that Gamaches feared.

For contemporary Jesuit authors, the demonstration that matter was distinct from extension was usually proven through the analysis of the mystery of the Eucharist. Extension is separable from matter through God's power, because, as it appears in the Eucharist, the matter of the host can change into the body of Christ while its extension and other qualities stay the same.³⁶ Suárez had famously stated at one point that the distinction between 'quantity' (=extension) and substance could not be fully demonstrated from rational reasons, but that it must

³⁶ Cf. the argument as provided by Suárez, DM XL, 2, 8: 'Prima ergo ratio pro hac sententia est quia in mysterio Eucharistiae Deus separavit quantitatem a substantiis panis et vini, conservans illam, et has convertens in corpus et sanguinem suum; id autem fieri non potuisset, nisi quantitas ex natura rei distingueretur a substantia. Neque sufficere potuisset distinctio modalis, quia substantia non potest esse modus quantitatis, ut per se notum est; deberet ergo quantitas esse modus substantiae; at vero modus non est ita separabilis ab illa re cuius est modus ut sine illa esse possit, ut in superioribus ostensum est; ergo quantitas non est tantum modus, sed res distincta a substantia.' That the accidents of the host inhere in quantity, rather than directly in substance, was a standard view (see Saint Thomas, *Sum. theol.*, IIIa, q. 77, a. 2), but not everyone inferred from it a real distinction between quantity and matter—namely, the nominalists did not. A nominalist position on the Eucharist was to say that the quantity of the *substance* of the bread was not maintained (its local presence as extended), but what was maintained were its quantified qualities (a quantified whiteness or a quantified taste). It was however harder to see how quantity could be applied univocally in this case to both these qualities and the substance, as Suárez pointed out in DM XL, 8, 10. See Ockham's *Tractatus de Corpore Christi*, ch. 19 ('Quod omnes qualitates in sacramento altaris non sunt unum subiectum unius quantitatis'), in *Opera theologica*, vol. 10, pp. 129–31 and the entire *De Quantitate*, in the same volume, pp. 1–86. For discussions of quantity, Anneliese Maier's studies are indispensable: 'Das Problem der Quantitas materiae in der Scholastik', in *Die Vorläufer Galileis im 14. Jahrhundert* (Rome: Edizioni di Storia e letteratura, 1949), pp. 26–52 and 'Das Problem der Quantität oder der räumlichen Ausdehnung', in *Metaphysische Hintergründe der Spätscholastischen Naturphilosophie*, (Rome: Edizioni di Storia e letteratura, 1955). See also D. Des Chene, *Physiologia*, pp. 97–109.

be held as a theological principle.³⁷ Suárez provided also a number of philosophical arguments against the Ockhamist identification of matter with extension, without holding them to be conclusive, but his separation between theological and rational arguments dissatisfied Des Bosses.

This reliance on the mystery of the Eucharist to explain the distinction between matter and extension represents a curious evolution in Latin Aristotelianism. Saint Thomas and his followers had a more straightforward explanation: matter was pure potentiality, while extension was actualized matter. However, most Aristotelians largely abandoned the distinction between actuality and potentiality by the seventeenth century. The result was this curious inversion: instead of explaining the miracle of transsubstantiation through the distinction between matter and extension, one explained the distinction between matter and extension through the miracle of transsubstantiation. In this sense, it is understandable that Des Bosses wanted to prove the distinction between matter and extension without appealing to the mystery of the Eucharist, on purely rational reasons.

7.3.1 Des Bosses on indivisibles

In order to do so, Des Bosses appeals to Leibniz. In a second argument for the distinction between matter and extension, Des Bosses used a mathematical proof with which Leibniz had provided him years earlier, in a letter from April 24, 1709. Leibniz had showed him a simple geometrical argument for the fact that mathematical points are not part of matter, and therefore cannot give rise to

³⁷ *'Approbatur sententia reipsa distinguens quantitatem a substantia. . . . Atque haec sententia est omnino tenenda; quamquam enim non possit ratione naturali sufficienter demonstrari, tamen ex principiis theologiae convincitur esse vera, maxime propter mysterium Eucharistiae.'* (DM XL, 2, 8).

extension.³⁸ But Des Bosses took this argument in a very different direction, inquiring over the ontological status of indivisible mathematical points, an issue much debated in late scholasticism.

Des Bosses uses an alternative and equivalent mathematical example, all the while recognizing that Leibniz had provided this mathematical proof. He divides a circle into sectors and considered the common vertex of the sectors, that is, the centre of the circle. These vertexes cannot be extended, because they converge in a mathematical point, non-extended. Can such mathematical points be something pertaining to matter (*aliquid materiae*)? If the mathematical points were themselves material, we would have a case of compenetration, and it follows that matter is non-extended because it is capable of compenetration. If the mathematical points were modes or accidents of matter, they would be inseparable from matter, and it follows that matter is present in the centre of the circle, and therefore capable of compenetration, therefore non-extended (f. 9).

The geometrical indivisibles are an issue much discussed in the medieval literature on *quantity* (an extended magnitude), to which Des Bosses refers here. We can use as a guide Suárez's extensive discussion from the 40th *Metaphysical disputation*, well known to Jesuit circles. The indivisibles are non-extended mathematical points that are used to explain the continuum of a magnitude. An extended magnitude is made up not only of extended parts, but also of non-extended indivisibles. In the category of indivisibles, some are 'terminative'—points, lines or surfaces—and some are 'continuative', which link the parts. The indivisibles did not compose the magnitude, its extended parts did; but the continuity and limits of the magnitude was given by the indivisibles. Regarding the ontological status of the indivisibles, Suárez held that they were modes of the

³⁸ LDB 124. Leibniz takes a triangle, draws a bisect line from one side to the vertex, and then divides the two triangles obtained again, and so on to infinity. Taken apart, each triangle obtained has its own vertex; taken together though, as to form a prism, they have a common vertex. Leibniz takes this to show that even with situation (*situs*, i.e., the situation of the triangles with respect to one another), one cannot have extension; extension adds continuity to situation ('*Extensio quidem exsurgit ex situ, sed addit situi continuitatem*').

extended magnitude that contains them: a line is a mode of the extended quantity that it delimits.³⁹

This modal distinction between the indivisibles and the extended magnitude held by Suárez, to which most non-nominalist scholastics subscribed, dissatisfied Des Bosses: he wanted to assign the mathematical indivisibles to matter, not to the extended magnitude, in order to prove that matter is non-extended. Des Bosses holds, against Suárez, that the *subject* of the indivisibles ‘does not arise at the same time’ as the continuation and division of the extended magnitude, but that it pre-exists the indivisibles.⁴⁰ He wants to say by this that the subject of the indivisibles is not extension, but a ‘pre-existing’ matter. The argument is not altogether clear, but Des Bosses seems to think that, since there

³⁹ The way this is expressed by Suárez is a little more complex. He argued, against the nominalist position, that points, lines and surfaces were modes distinguished *ex natura rei* from quantity but *realiter* identified with quantity (DM XL, 5, 38: ‘hic non potest satis intelligi quod punctum aut quodlibet indivisibile terminans sit tantum modus ex natura rei distinctus et realiter identificatus quantitati quam terminat’). For Suárez’s terminology of distinctions, see DM VII, 1. A real distinction *ex natura rei* occurs when two entities can subsist by themselves, at least through God’s absolute power. A modal distinction *ex natura rei* applies to a couple of entities out of which only one can subsist without the other. Quantity can subsist without delimitating itself into points, lines, or surfaces. *Ex natura rei* refers to the fact that both entities have a positive being in things, either as substance, an accident, or mode. For the ontological status of the indivisibles, see DM XL, 5 (‘Utrum in quantitate continua sint puncta, lineae et superficiae quae sint verae res, inter se et a corpore quanto realiter distinctae’). Suárez, as usual, summarizes the opinions on this issue. One is that the points have no distinct *res* apart from substance (Suárez names the nominalists, Durandus, Ockham or Gregory of Rimini). The realist opinion is that the points, lines and surfaces, can be distinguished not only among themselves, but also from the bodies to which they belong, or from quantity (Suárez names Saint Thomas ‘and the members of his school’, Capreolus, Soncinas, Domingo de Soto, Cajetan, but also Duns Scotus, Alexander of Hales or Walter Burley).

⁴⁰ ‘Dicendum itaque est subjecta indivisibilium sive terminantium in divisione et continuatione non ori[r]i nec interire, sed praeexistisse in puncto etc. in quo fit divisio v.g. in centro ex quo conficitur, cum divisio sit possibilis in infinitum in quolibet puncto continui, infinita esse indivisibilia materiae.’ (F. 11).

are an infinity of virtual indivisibles in any given point, then only matter, which is virtually infinitely divisible, can be their subject. And so, if the non-extended indivisibles inhere in matter as *modes*, then matter is itself non-extended; therefore extension must be something superadded to it: an absolute accident. The argument is, to my mind, at least paradoxical, because it relies on the fact that the points, lines and surfaces, which are supposed to be indivisible, are virtually divisible in an infinity of other points, lines and surfaces.

Curiously enough, Des Bosses looked for additional support in modern literature. He quoted Descartes's demonstration of transubstantiation through the permanence of the surface of bodies from *Replies IV* (AT VII 247ff.). Descartes, indeed, had held that the surface of the bread is neither a part of the substance of the bread nor a part of its quantity, but that it was the medium between the bread and the surrounding bodies. Since this mode, the surface, could not be assigned to one body or the other, Des Bosses reasoned that it must inhere in matter.

Des Bosses also found support for the view from the Newtonians (*neoterici Angli*). He appeals to John Keill, the mathematician who had accused Leibniz of stealing the calculus. Keill had held, in his lectures on Newtonian mechanics from 1700, that an Aristotelian real distinction between body and *space* could be supported. He argued, much like Des Bosses, from the fact that non-extended points, lines and surfaces are modes inhering in matter that matter can be taken to be something apart from body—namely, space.⁴¹

⁴¹ To correct a shortcoming in Michel de Certeau's otherwise informative editing, in 'La « Clavis Lycaeï », p. 587: 'Nous n'avons pu contrôler cette référence à Jean Kal' [?]), Des Bosses refers to John Keill's (1671–1721) popular book *Introductio ad veram physicam: seu lectiones physicae habitae in schola naturalis philosophiae academiae Oxoniensis, A.D. 1700. Quibus accedunt Christiani Hugonii theoremata de vi centrifuga & motu circulari demonstrata*, published in Oxford in 1701. I use the sixth edition (London, Geo Strahan, and Cambridge: G. Thurlbourn, 1741), pp. 21–34. See pp. 25–6: 'Verum, etiamsi nec superficies, nec lineae, nec puncta sunt ipsa materia, in ea tamen existunt, vel existere possunt, tanquam illius modi, termini, seu accidentia.'

7.3.2 Des Bosses on hylomorphism and the radical union

Des Bosses raised against himself the same objection he had raised against Leibnizian phenomenalism: if we hold that matter is composed out of non-extended indivisibles, and nothing else, why would extension itself not be resolved into the same non-extended indivisibles? Why do we need extension on top of matter?

His answer is that extension supposes a ‘union of parts’ that matter by itself cannot have. The distinction between matter and extension, Des Bosses explains, is that between a *primary* subject of inherence and a *secondary* subject of inherence. A primary subject of inherence is, in traditional Thomism, prime matter, devoid of all form; a secondary subject of inherence is extension, which inheres in prime matter and serves itself as a subject of inherence for other modes (colour, for instance). As a primary subject of inherence, Des Bosses says, (prime) matter is devoid of ‘all modes and forms, and similarly of all unions and localizations.’⁴² Extension, on the other hand, presupposes a material body, composed out of matter and form. Therefore, extension can have, included in its notion, a ‘radical union’ of parts, such as the union between matter in form. This radical union is incompatible with the concept of (prime) matter, pure subject. He explains:

Since extension is an absolute thing, as we have shown, but not a primary being, it presupposes in fact by its nature a material body, or a composite (as it will be shown elsewhere), or a blend

⁴² ‘Discrimen inter materia et quantitatem sive extensionem esse quod materia sit subjectum primum. Subjectum autem primum qua tale concipi debet ut praecisum a quibuscumque modis et formis, adeoque ab unionibus et sitibus.’ (F. 12).

[*conflatum*] of matter and form. An absolute, non-primary being can certainly include in its idea or concept the radical union of a part with another part. But this is incompatible with the concept or notion of matter and primary subject.⁴³

A ‘radical union’ of parts is defined as an actual union applied to those parts that cannot coexist otherwise, unless united (matter and form, for instance). This kind of radical union cannot be placed in matter, because matter is infinitely divisible. One can subtract parts of matter, *ad infinitum*, and put them back together or replace them, without consequences for the whole.⁴⁴ But an amputated member of an animal, Des Bosses argued, cannot be replaced just as easily. That member will no longer have the same extension it had when it was united with its body. Its new cadaveric form will have to inhere in a new extension.⁴⁵

One can see that this argument depends on the Thomist doctrine that a body has one single substantial form, which sustains its individual quantity. According to the Thomist view onhylomorphism, a body is made one in virtue of the substantial form it has. Once it loses that form, it loses *all* of its accidents, including quantity. If one would admit partial forms or the divisibility of form, Des Bosses’s argument would fail, and he recognized this limit (f. 14). It is a strong

⁴³ ‘Extensionem esse quidem absolutum quid, uti probavimus, sed non ens primum, supponit enim natura prius materiam, sive (ut alibi probandum est) compositum, sive conflatum ex materia et forma substantiali. Potest quidem res absoluta non prima in idea sive conceptu suo involvere unionem radicalem partis ad partem. Repugnat autem id conceptui sive notioni materiae et subjecti primi.’ (F. 12–13)

⁴⁴ ‘Scilicet omnis pars assignabilis determinata materiae primae potest separari, tam mediate quam immediate, a quacumque alia determinata parte materiae, et idem dicendum de separatione cujuscumque indivisibilis materiae a quocumque indivisibili alio.’ (F. 13).

⁴⁵ According to the known Thomist position on accidental forms (f. 14).

interpretation of the principle of the convertibility of unity and being (*ens et unum convertuntur*).⁴⁶

Conclusion

Leibniz's familiarity with the doctrines of the Aristotelians of his time has been long appreciated by scholars. However, this dimension is mostly overlooked in the otherwise very thorough commentaries we have on the correspondence with Des Bosses. The major part of the scholarship devoted to these letters concerns, as is only natural, the development of Leibniz's views on corporeal substance and on the union of monads expressed in the notion of the *vinculum substantiale*. A lot of scholarly energy has been devoted to the question of whether Leibniz had held the *vinculum substantiale* in the first place. I believe that there is something to be gained in looking at the correspondence as a dialogue between two philosophical minds, rather than as an interview given by Leibniz on his monadology. Leibniz constructed, refined and sometimes altered his views, for the most part, by confronting competing 'systems', be they Cartesian, Aristotelian, Spinozist, Lockean, occasionalist, or pretty much any of the philosophical products accessible to the late seventeenth century. Given the fact that Leibniz's thought is sustained by this constant input from occasional causes (to use an expression of Vittorio Mathieu's),⁴⁷ the recovery of the role played by scholastic doctrines in the correspondence with Des Bosses is all the more important.

⁴⁶ 'Quia cum ens et unum convertantur, hoc ipso quo quantitas membri abscissi amittit unitatem, quae fundatur in unitate vel indivisibilitate formae, amittit etiam existentiam suam, et forma cadaverica membri abscissi accipit novam quantitatem, juxta sententiam Sancti Tomae asserentis nullum accidens manere in corrupto quod fuit in vivo. At in reliquo corpore animalis adhuc superstitis remaner[e] adhuc eadem quantitas partialis partibus vivis respondens, quia in eodem remanet adhuc eadem forma substantialis.' (F. 13–14).

⁴⁷ V. Mathieu, *Leibniz e Des Bosses*, p. 7, on the 'dialogicità del pensiero leibniziano.'

We have a good idea, from Alfred Boehm's important and singular study, of the extent to which the central philosophical notion of the text, that of the *vinculum substantiale*, is tributary to developments in late scholastic views on substantial union.⁴⁸ Boehm worked within a continuity-discontinuity framework, aiming to show the extent to which post-Scotist notions of substantial union were or were not followed by Leibniz. Rather than looking at Leibniz's immediate scholastic background, I focused my discussion on Father Des Bosses himself, as a first-hand guide to how a Thomist-leaning Jesuit could think of the relationship between the Aristotelian metaphysics of substance and Leibniz's monadology.

Des Bosses too proposed a picture of an 'emended peripatetic philosophy', one that mingled some Leibnizian and Aristotelian elements. It is hard not to see in Des Bosses's indivisibles an echo of Leibniz's monads—Des Bosses himself uses the word—, or in his 'radical union', an echo of the *vinculum*. But Des Bosses had a radically different project, one of restoring the distinction between matter and extension, which would avoid grounding it either in the couple potentiality-actuality or in the mystery of the Eucharist. The idea that the mathematical indivisibles are constituents of matter, and not modes of quantity, was a sort of a hybrid product, based on both Leibniz's monads and on the late medieval notion of quantity, but in which neither theories were adequately represented. We have at the bottom non-extended primary matter, consisting of non-extended indivisibles or monads; at a second level, corporeal substances, capable of extension in virtue of a 'unio radicalis' between their matter and their form. While

⁴⁸ *Le « vinculum substantiale » chez Leibniz*. Boehm was looking for a 'positive genesis' (p. 3) of the *vinculum* in Leibniz's immediate predecessors, against Blondel's thesis. R. Jolivet, *La notion de substance. Essai essai historique et critique sur le développement des doctrines d'Aristote à nos jours* (Paris: Beauchesne, 1929) had already found the notion in Suárez; see R. Jolivet, 'Suárez et le problème du « vinculum substantiale »', in *Actas del IV centenario del nacimiento de Francisco Suárez, 1548–1948* (Madrid: Dirección General de Propaganda, 1950), vol. 1, pp. 235–50. Boehm's material concerns mainly anti-Thomist seventeenth-century scholastic views on the union in the 'substantial whole' (*totum essentiale*) and the 'integral whole' (*totum integrale*). However incomplete, it remains the only study of the issue.

the arguments that Des Bosses provides are less than coherent, the picture he wants to arrive bears the familiar face of Aristotelianism.

The main difference between the picture from the *Clavis Lycae*i and the Leibnizian view of substance lies in the conception of the indivisibles or monads, and Des Bosses reiterates in this text his main objection to Leibniz's vinculum. Leibniz and Des Bosses both agree that we need to add a unity through a substantial form that holds together the indivisibles/monads and gives extension to the composed substance. But the agreement stops here. One objection that Des Bosses addresses to himself in the *Clavis Lycae*i is:

If one can conceive matter as a collection of non-extended and indivisible things, then we already have in matter unities or monads without the help and intervention of a substantial form that would attribute unity to these indivisibles. For those indivisibles alone, by the very fact that they are indivisibles, are obviously one.⁴⁹

Des Bosses's refutation consists in denying this unity and substantiality to the monads. The reasoning is simple: if the monads have per se unity, they can exist separately from any superadded union, in their non-extended state, and nothing posterior to that can make them extended. The only alternative for saving the reality of the world would be to admit extended atoms. That was not an option, and we would end up with aggregates anyway.⁵⁰ I take Des Bosses's

⁴⁹ 'Si materia concipi potest tanquam collectio inextensorum et indivisibilium, jam in materia habebuntur unitates sive monades absque ope et interventu formae substantialis quae indivisibilibus istis unitatem tribuat. Nam singula illa indivisibilia, hoc ipso quo indivisibilia, erunt una ut patet.' (F. 14).

⁵⁰ 'Sed certum est dari substantia sensibilem et extensam sive dari corpora, uti postulavimus vel supposuimus, ergo indivisibilia illa materiae nequeunt esse prima entia completa, sed collectio illorum indivisibilium solum poterit esse pars substantiae corporeae et extensae

opposition to the *vinculum* from an Aristotelian point of view to be pertinent: monads, as complete substances, cannot fit into an Aristotelian conception of material substance.

In 1735, the idea of Leibnizian monads was gaining strength through Wolff's success. The *Ontologia* was published in 1730, followed quickly by the entire system in a sustained rhythm of publications. The Leibnizian *vinculum substantiale* and his final conception of corporeal substance were not gaining any followers, obviously, since the correspondence was not known, and so the path was open for the triumphal march of German idealism. Des Bosses saw Leibnizian idealism up close, and he wanted to resist it. About Wolff, he wrote: 'I do not see through which reason those that do not admit any other proper substance besides simple, indivisible and non-extended entities can hold that their aggregates are extended' (f. 16).⁵¹ The alternatives were clear for him; no *vinculum* could fill this gap.

Quod si indivisibilia illa metaphysica essent verae unitates substantiales, jam nulla daretur substantia extensa.' (F. 15).

⁵¹ 'Nec vero video qua ratione ii qui nullam substantiam proprie dictam agnoscunt praeter entia simplicia, indivisibilia et inextensa, tueri possint aggregata illorum esse extensa. Videri potest Wolfius . . .' (F. 16).

General conclusion

A general conclusion that would piece together the material presented in the preceding chapters is not only unlikely, but also contrary to the non-linear story telling advocated in the introduction. The reception of Aristotle's *Meteorologica* throughout the later middle ages and the early modern period has brought us to consider the theory of science in the fourteenth century, the theory of mixture in Duns Scotus and his medieval predecessors, the definition of the field of meteorology as a the science of imperfect mixtures, the split of the *Meteorologica* books and the delimitation of the Aristotelian course of physics according to this definition, the complex causal mechanism involved in meteorological accounts, the rejection of the theory of mixtures by Descartes, and the dawn of a new discipline based on the geographical situation of the meteors. The other thread of our research, the history of hylomorphic theory, has brought us to consider the permanence of the elements in the mixture, the generation of the form of the mixture, problems of generation and corruption, Descartes's nominalist arguments for the rejection of material hylomorphism, the reactions of the Aristotelians in Leuven to that rejection, and, finally, the attempt to reconstruct an Aristotelian doctrine of corporeal substance in the early eighteenth century by Leibniz and Des Bosses.

The 'standard' Aristotelian meteorological theory presented in chapter 4, through Fromondus, constitutes the central point of our analysis, towards which the results of all the other chapters converge. This is not to say that the 'Fromondus standard' is a monolith, or a unity of measure. It simply has a greater

concentration of common elements susceptible to be found in a larger number of other treatises.

One of the dissidents from this standard was Father André Dabillon (d. *ca.* 1664), a prolific character (formerly a Jesuit, for a while associated with the pietist Jean de Labadie), who liked to dedicate his books to none other than the Holy Ghost, and who wrote a complete system of (para-)Aristotelian philosophy. His system is composed out of a metaphysics, a physics, and an ethics, all of them ‘familiar and solid’, written in vernacular, abridged in little more than two thousand pages, for the ‘bons esprits’ of the age.¹ His *Physics* differs in a number of crucial respects from the ontological representation of the meteors we have presented, while remaining in the Aristotelian spectrum. Dabillon takes as his master the improbable William of Ockham and has a peculiar theory of substance, based on which he divides his physics. Substances are perfect and imperfect (*accomplies* or *inaccomplies*). Perfect substances are Aristotelian primary substances: God, an angel, a man, or a lion. Imperfect substances are meant to be naturally united with one another: matter and form are such substances, or body and soul.² Physics treats first perfect substances and then imperfect substances. The general principles applicable to all bodies are divided into substance, accidents and modes. The meteors are part of Book IV, which deals with particular non-animated bodies, starting from the skies and going down, in a descending order of perfection, to the elements, the metals, stones and, finally, the meteors. Non-animated bodies are divided into simple, the heavens and the elements, and mixed, everything else. There are no imperfect bodies for Dabillon. The meteors, treated in a chapter on the element of air, are *perfect* (!) corporeal substances (*êtres corporels accomplis*), composed out of matter and form, and originated out of vapours and exhalations.³ The efficient cause

¹ *La métaphysique des bons esprits, ou l'Idée d'une métaphysique familière et solide* (Paris: S. Picquet, 1642); *La physique des bons esprits, ou l'Idée et abrégé d'une physique familière et solide divisée en cinq livres* (Paris: S. Piquet, 1643); *La morale des bons esprits, ou l'Idée et abrégé d'une morale familière et solide* (Paris: S. Piquet, 1643).

² *La physique*, p. 55.

³ *La physique*, p. 534–5.

responsible for the production of the meteors is either the Sun, by attracting the exhalation to itself, or the Earth, by pushing it out. Vapours and exhalations are not distinct among themselves essentially, but only through their accidental qualities. Nor are they essentially distinct from the pure elements of water and earth. The only distinction between the vapours vs. exhalations and water vs. earth is given by the qualities of gravity and levity induced in them by the celestial bodies. The final cause of the meteors is the beauty of the Universe. The formal cause is the form of their original element, taken together with some accidental qualities. We will consequently have three types of meteors: aqueous, airy or fiery (there are no earthly ones). Mixed bodies are distinguished from the elements by the fact that they have their own form and they can produce all four elementary qualities, while the elements can only produce two by their nature. The form of man, the human soul, is the exception, in that it is indivisible and could not be composed out of the forms of the elements. Nor could the partial forms of the parts of the human body have an elementary composition, because the four elements cannot coexist in the same place at the same time.⁴

This is a meteorological doctrine very different from what we have encountered, but one that is composed nevertheless out of Aristotelian elements. The curious case of André Dabillon will mark the end of our story.

⁴ *La physique*, 565–7.

Summary

This thesis is a study of the ontological problem of mixed bodies in the Latin Aristotelian tradition and of its consequences for the evolution of meteorology as a discipline. The corpus is given by figures from the fourteenth, sixteenth and seventeenth centuries. It treats material from Avicenna, Averroes, Thomas Aquinas, Duns Scotus and Pseudo-Scotus, Themon Judaeus, Zabarella, Péter Pázmány, Libertus Fromondus, Descartes, Jacques du Roure, Jacques Rohault, Pierre Sylvain Régis, Fortunatus Plempius, Leibniz and Des Bosses.

For Aristotle, material bodies have a double conceptual determination: they are mixtures of the four elements and, at the same time, they are composed out of matter and form. Hylomorphism is meant to explain, foremost, not what bodies are made of, but how do they change by passing from one form to another. The theory of elements and mixtures, on the contrary, is meant to explain what is the ultimate structure of bodies. The use of hylomorphism in the scientific description of material bodies encounters a number of difficulties. This happens especially when this doctrine is taken together with the theory of elements: are the elements themselves composed out of matter and form? Does the form of the elements survive in the mixture? How is the substantial form of the mixture acquired? Do mixtures have one single substantial form? Can there be imperfect substances, such as meteorological bodies, midway between the elements and complete mixtures? I am investigating these topics in several studies on individual figures or works, which retrace a history of the main solutions proposed by Latin Aristotelianism to this under-determination in Aristotle's concept of matter. The core of our analysis is concerned with the conceptualization of meteorological

bodies as mixtures and with the question of how hylomorphism and the theory of mixture structures the Aristotelian course of physics.

The chapters of the thesis treat, specifically, the following themes: the conception of meteorology as a science in the Aristotelian tradition: the problem of the object of science in fourteenth-century meteorology (Themon Judaeus and Pseudo-Scotus, chapter 1); the interpretations offered by the medieval tradition to Aristotle's notion of mixture (Avicenna, Averroes, Thomas Aquinas) and Duns Scotus's rejection of the doctrine (chapter 2); the place of meteorology in the Jesuit course of physics and the generation and corruption of mixtures (Péter Pázmány, chapter 3); seventeenth-century Aristotelian meteorology: the shape of the field as seen through Libertus Fromondus, the definition and causes of the meteors, and his defence of the Aristotelian conceptual framework against attacks from various Renaissance *novatores* (chapter 4); Descartes's treatise on *The Meteors* as directed against the Aristotelian theory of mixtures and his rejection of physical hylomorphism (chapter 5). Finally, Part II completes our study with a look at hylomorphism in early modern authors: a study of Descartes's reception in Leuven by Plempius and Fromondus, which reveals that his rejection of hylomorphism was one of the main reasons for his condemnation (chapter 6); and a study of Des Bosses's and Leibniz's attempts to salvage the Aristotelian conception of corporeal substance (chapter 7).

During these studies, we explore a lot of uncharted territory: we establish the paternity of a series of *quaestiones* falsely attributed to Duns Scotus or Simon Tunstead, we date Pázmány's manuscript lectures on meteorology, while figures such as Themon Judaeus, Fromondus, Plempius and Des Bosses are very little known. The research on hylomorphism is meant to bring new elements for approaching the complex problem of why hylomorphism was abandoned in the seventeenth century in favour of corpuscularianism. My investigation shows that the conception of mixture is a central issue in this shift. There were intrinsic problems with it, various solutions were offered within Aristotelianism, and some Aristotelian authors (e.g., Duns Scotus) did recognize these problems. At the same time, the theory of mixtures was essential for the composition of a coherent Aristotelian physical doctrine, as the need for it became more acute because of pedagogical concerns developed in the sixteenth century. The rejection of the

Aristotelian theory of mixtures in the seventeenth century, by Descartes for instance, brought a drastic change in the course of physics and in the conception of meteorology. From a science based on ontological principles, which understood the meteors as imperfect mixtures that do not have a substantial form of their own, meteorology becomes a science that delimits its subject based on geographical principles: meteors are just phenomena of the lower atmosphere. Finally, each chapter brings a contribution to the scholarship devoted to individual authors, be they major figures such as Duns Scotus and Descartes, or lesser-known authors.

Samenvatting

Deze dissertatie is een onderzoek naar het ontologische probleem van gemengde lichamen in de Latijns-Aristotelische traditie, en naar de gevolgen ervan voor de ontwikkeling van de meteorologie als discipline. Het corpus bestaat uit teksten van figuren uit de veertiende, zestiende en zeventiende eeuw. Het behandelt materiaal van Avicenna, Averroes, Thomas Aquinas, Duns Scotus en Pseudo-Scotus, Themon Judaeus, Zabarella, Péter Pázmány, Libertus Fromondus, Descartes, Jacques du Roure, Jacques Rohault, Pierre Sylvain Régis, Fortunatus Plempius, Leibniz en Des Bosses.

Volgens Aristoteles hebben materiële lichamen een dubbele conceptuele determinering: ze zijn mengsels van de vier elementen; tegelijkertijd zijn ze opgebouwd uit materie en vorm. Het voornaamste doel van hylomorfisme is niet zozeer een verklaring te geven voor de samenstelling van lichamen, maar wel voor de wijze waarop lichamen van vorm veranderen. De theorie van elementen en mengsels, daarentegen, stelt zich als doel de ultieme structuur van lichamen te verklaren. Het gebruik van hylomorfisme in de wetenschappelijke beschrijving van materiële lichamen stoot op een aantal problemen. Dit is in de eerste plaats het geval wanneer deze doctrine gecombineerd wordt met de theorie van de elementen: zijn deze elementen zelf samengesteld uit materie en vorm? Blijft de vorm van de elementen bewaard in het mengsel? Op welke wijze komt de substantiële vorm van het gemengde lichaam tot stand? Hebben gemengde lichamen één enkelvoudige substantiële vorm? Kunnen er imperfecte substanties bestaan, zoals meteorologische lichamen, die het midden bewaren tussen de elementen en de complete mengsels? Ik behandel deze onderwerpen in diverse

studies over individuen en werken, waarbij de belangrijkste oplossingen voorgesteld door de traditie van het Latijns Aristotelianisme worden teruggebracht tot deze onderdeterminatie in Aristoteles' concept van materie. De kern van onze analyse betreft de conceptualisering van meteorologische lichamen als gemengde lichamen, en de problematiek van hoe hylomorfisme en de theorie van mengsels de Aristotelische studie van de fysica structureert.

Meer specifiek behandelen de hoofdstukken van de dissertatie volgende thema's: de conceptie van meteorologie als een wetenschap in de Aristotelische traditie: het probleem van het object van wetenschap in de veertiende-eeuwse meteorologie (Themon Judaeus and Pseudo-Scotus, hoofdstuk 1); de interpretaties van Aristoteles' notie van mengsels aangereikt door de middeleeuwse traditie (Avicenna, Averroes, Thomas Aquinas) en Duns Scotus' verwerping van de doctrine (hoofdstuk 2); de plaats van meteorologie in de Jezuïtische studie van de fysica en de generatie en corruptie van gemengde lichamen (Péter Pázmány, hoofdstuk 3); zeventiende-eeuwse Aristotelische meteorologie: de toestand van de discipline zoals gezien door de ogen van Libertus Fromondus, de definitie en oorzaken van meteoren, en zijn verdediging van het Aristotelische conceptuele kader tegen de aanvallen van verscheidende Renaissance *novatores* (hoofdstuk 4); Descartes' verhandeling over *The Meteors* zoals gericht tegen de Aristotelische theorie van mengsels en zijn verwerping van fysisch hylomorfisme (hoofdstuk 5). Finaal, twee hoofdstukken die onze studie vervolledigen en een blik werpen op hylomorfisme bij vroeg moderne auteurs: een studie van Descartes' receptie in Leuven door Plempius en Fromondus, waarbij aangetoond wordt dat de verwerping van hylomorfisme door eerstgenoemde een van de centrale redenen was voor diens veroordeling (hoofdstuk 6); en een studie van Des Bosses' poging tot redding van de Aristotelische conceptie van lichamelijke substantie tijdens diens confrontatie met Leibniz (hoofdstuk 7).

Tijdens deze studie verkennen we vele onontgonnen terreinen: we wijzen het vaderschap toe aan een serie van *quaestiones* verkeerdelijk toegedicht aan Duns Scotus of Simon Tunstead; we dateren Pázmány's manuscript-lezingen over meteorologie; we behandelen weinig bekende auteurs als Themon Judaeus, Fromondus, Plempius en Des Bosses. Dit onderzoek naar hylomorfisme brengt elementen naar voor die een nieuw licht werpen op het complexe probleem

waarom hylomorfisme in de zeventiende eeuw verworpen werd ten voordele van de corpusculaire theorie. Het onderzoek toont aan dat de conceptie van gemengde lichamen een centrale rol innam in deze evolutie; het concept kampte met intrinsieke problemen, meerdere oplossingen werden gesuggereerd vanuit het Aristotelisme, en bepaalde Aristotelische auteurs (bijvoorbeeld Duns Scotus) erkenden deze problematiek. Terzelfdertijd was de theorie van gemengde lichamen essentieel voor de ontwikkeling van een coherente Aristotelische fysische doctrine; dit mede gestuurd door de pedagogische noden die zich manifesteerden in de zestiende eeuw. De verwerping van de Aristotelische theorie van gemengde lichamen in de zeventiende eeuw, bijvoorbeeld door Descartes, veroorzaakte een drastische wijziging in de studie van de fysica en de conceptie van meteorologie. Oorspronkelijk een wetenschap gebaseerd op ontologische principes, waarin meteoren begrepen werden als imperfecte mengsels zonder eigen substantiële vorm, ontwikkelde de meteorologie zich tot een wetenschap die zijn onderzoeksobject afbakt op basis van geografische principes: meteoren zijn niet meer dan fenomenen uit de lagere atmosfeer. Tenslotte draagt elk hoofdstuk bij tot de geleerdheid van de individuele auteurs, zowel van grote figuren als Duns Scotus en Descartes als van minder bekende auteurs.¹

¹ Translated by Jo Van Cauter, whom I thank.

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